NORTHEAST ELECTRONICS

A DIVISION OF NORTHERN TELECOM, INC.

INSTRUCTION MANUAL

TTS 75A

RELAY TIMING TEST SET

No. A0075-12-600 ISSUE 4 DATE MAR 1977

PRINTED IN U.S.A.

Airport Rd., Concord, N.H. 03301 • (603) 224-6511 • TELEX 94-3453

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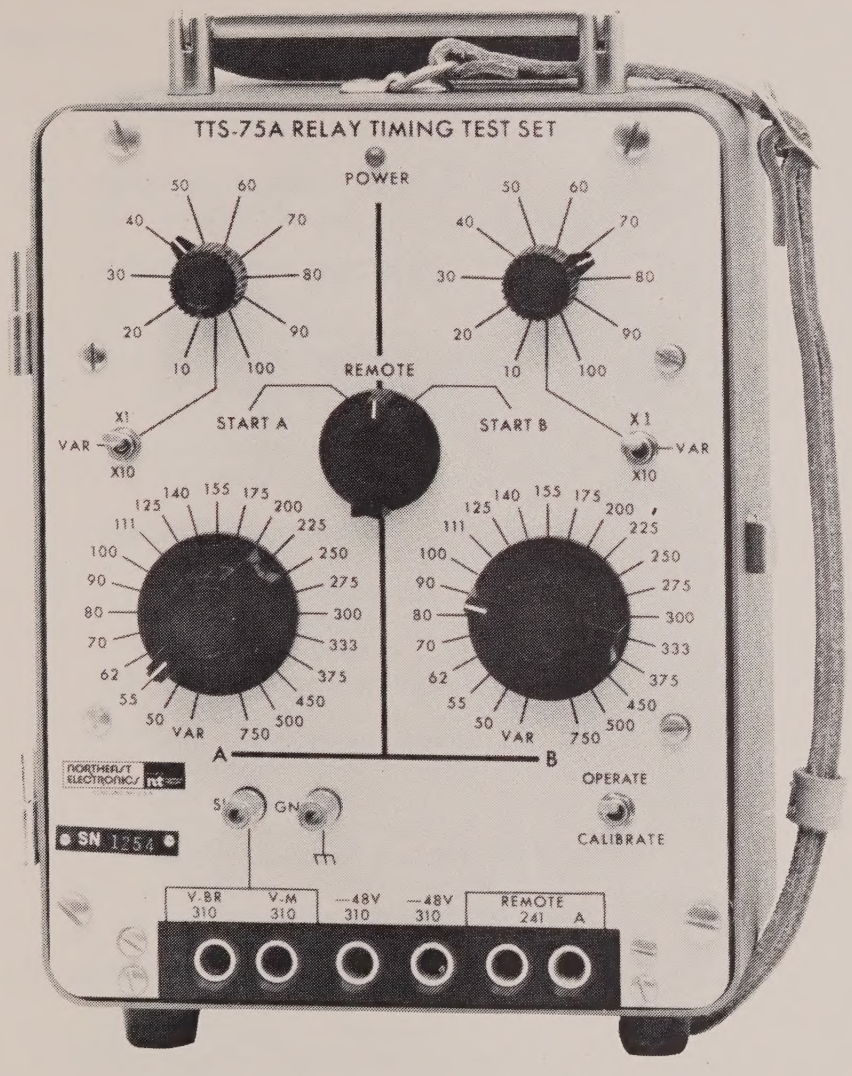

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SECTION 1

DESCRIPTION

1.1 INTRODUCTION.

1.2 The Northeast Electronics Model TTS 75A is a portable, precision Relay Timing Test Set. The set is capable of providing precisely timed dry contact make and break intervals at type 310 jacks on the front panel. The make and break time intervals are selected individually and will occur sequentially and continuously upon command from a front panel switch or a Model TTS 75RCAE Remote Control Unit.

1.3 Timed intervals for make and break are selected by controls on the front panel. The intervals can be preset to any of 22 settings ranging from 50 milliseconds to 750 milliseconds, or they can be varied over a range from 10 milliseconds to 1 second. Synchronize start, continuous sequence, and stop functions within the TTS 75A test set is controlled by integrated circuit logic. Power for the TTS 75A test set requires a 48-volt central office battery. Other office battery voltages can be accommodated by optional factory adjustment.

SECTION 2

SPECIFICATIONS

2.1 INTRODUCTION.

2.2 Table 2—1 lists the electrical and physical specifications for the Model TTS 75A.

Table 2—1. TTS 75A Specifications.

MAKE AND BREAK TIMING	
Preset Intervals:	50 ms to 750 ms in 22 switch-selected increments, plus 222 ms break interval.
Variable Intervals	10 ms to 1 sec. continuous potentiometer-selected coverage.
TIMING MODES	
Calibrate:	Make and break intervals selected independently and both intervals sequence continuously.
Operate:	Make interval selectable, break interval always 222 ms, both intervals sequence continuously.
TIMING ACCURACY	
Preset Intervals:	Switch setting ± 1 ms
Variable Intervals:	Dial setting ± 10% ± 1 ms above 10 ms setting. (±3 ms at 10 ms setting.)
Fixed Break Interval:	222 ms ± 1 ms
Accuracy vs Temperature:	Accuracy preserved as specified above from −4°C to +52°C (+25°F to +125°F)
MAKE AND BREAK OUTPUT	
Contact Closures:	Dry C-form
Contact Rating:	2 amp maximum
PHYSICAL FEATURES	
Dimensions:	7 in. (178 mm) w x 9 in. (229 mm) h x 7½ in. (191 mm) d
Weight:	7.25 pounds (3.3 kg)
POWER REQUIREMENTS	
Voltage:	42 to 56V dc
Current:	250 mA typical

SECTION 3

OPERATING INSTRUCTIONS

3.1 INTRODUCTION.

3.2 Table 3—1 lists the functions of all controls, connectors and indicators called out on Figure 3—1. Operating features are described in paragraphs 3.3 through 3.10, and operating procedures begin at paragraph 3.11.

Table 3—1. TTS 75A Front Panel Controls, Indicators, and Connectors.

REF DESIG	CONTROL, INDICATOR OR CONNECTOR	FUNCTION
DS1	POWER LAMP (green)	Indicates 48 volt source is connected at —48V 310 jack J3 or J4 and power supply is operating. Lamp lights on 5 volts dc from Variable Timer circuit board.
J1	V—BR 310 jack	Provides for tip and ring connection of relay under test to normally-closed break contacts of polar relay K1.
J2	V—M 310 jack	provides for tip and ring connection of relay under test to normally-open make contacts of polar relay K1.
J3, J4	—48V 310 jacks	Provides for tip (—48V) and sleeve (ground) connection to central office battery and to accessory equipment requiring 48 volts dc. These jacks are connected in parallel.
J5, J6	REMOTE 241 and A jacks	Provides connection for TTS 75RCAE Remote Control Accessory. Notch side of type 241 plug on RCAE cord must be inserted in A jack J6.
J7	SL binding post	Provides for connection to sleeve of jacks J1 and J2. When connected to ground binding post J8, a busy condition is indicated for the circuit under test.
J8	GROUND binding post	Provides convenient external chassis ground connection for test purposes. See Function of J7.
R1	A VAR 10—100 potentiometer	Provides continuously variable adjustment of interval A duration produced by Variable Timer PC4. The duration of this interval equals the setting of R1 (in milliseconds) times 1 or times 10, depending on the position of A VAR X1X10 switch S3.
R2	B VAR 10—100 potentiometer	Provides continuously variable adjustment of interval B duration produced by Variable Timer PC4. Duration of this interval equals the setting of R2 (in milliseconds) times 1 or times 10, depending on the position of B VAR X1X10 switch S4.

Table 3—1. (cont'd)

REF DESIG	CONTROL, INDICATOR OR CONNECTOR	FUNCTION
S1	START A—REMOTE—START B rotary switch	START A or START B position selects the A or B duration for the make interval at jack J2, and starts continuous sequencing of make/break intervals. The REMOTE position stops the test set; also allows the function of switch S1 to be duplicated by an RCAE unit at jacks J5 and J6.
S2	OPERATE CALIBRATE toggle switch	OPERATE position inhibits the A and B time durations, as selected by front panel controls, from determining the break interval at jack J1. The break interval will be 222 milliseconds for all sequencing of make and break intervals, so long as switch S2 is in the OPERATE position. CALIBRATE position enables A and B time durations, as selected by front panel controls, to determine the make and break intervals at jack J1 and J2 for all sequencing of make and break intervals.
S3	A VAR X1 X10 toggle switch	Provides a second range of interval A duration as determined by A VAR 10—100 potentiometer R1. Refer to the Function column for R1.
S4	B VAR X1 X10 toggle switch	Provides a second range of interval B duration as determined by B VAR 10—100 potentiometer R2. Refer to the Function column for R2.
S5	A rotary switch	VAR position "steers" look-at-A commands from Information Processor PC1 to the A side of Variable Timer PC4, which produces the interval A time duration selected by potentiometer R1 and switch S3. Any position other than VAR "steers" look-at-A commands from Information processor PC1 via Diode Matrix PC3 to Preset Timer PC2, which produces the interval A duration selected by the specific S5 switch position.
S6	B rotary switch	VAR position "steers" look-at-B commands from Information Processor PC1 to the B side of Variable Timer PC4, which produces the interval B time duration selected by potentiometer R2 and switch S4. Any position other than VAR "steers" look-at-B commands from Information Processor PC1 via Diode Matrix PC3 to Preset Timer PC2, which produces the interval B time duration selected by the specific S6 switch position.

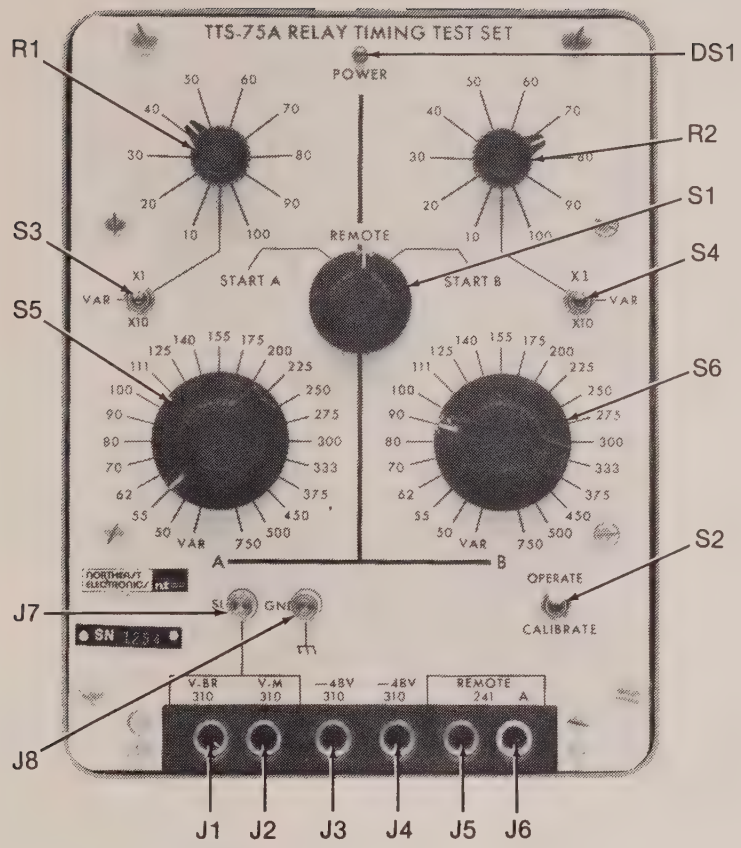


Figure 3—1. TTS 75A Controls, Indicators, and Connectors.

3.3 OPERATING FEATURES.

3.4 The TTS 75A uses a dry contact C-form polar relay, the wiper of which is controlled by internal circuitry causing it to switch from one fixed contact to the other. The duration of the closure with each fixed contact is programmable from the front panel.

3.5 The TTS 75A is intended for use in calibration of slow-to-operate and slow-to-release relays. The calibration is performed by operating the relay under test using the dry contacts and watching the contacts of the relay under test while adjusting for correct operation. Since the closure times are precisely controlled, the TTS 75A can be used to assure correct time delays to within 1 millisecond of delays available on the preset switches.

3.6 In order to calibrate relays, correct operate and release times must be used. Usually the operate time varies for different relays while the release time is fixed at 222 milliseconds. However, some release times differ from 222 milliseconds. The OPERATE—CALIBRATE switch is used to select a fixed release time of 222 milliseconds (OPERATE) or a programmed release time (CALIBRATE).

3.7 Dual programming controls provided are marked A and B. The two sets of controls are identical but independent. Each set has a large 23-position switch with markings from 750 down to 50 and VAR. This means that the number under the knob pointer is the programmed duration (in milliseconds) for that control. The 22 numbered positions include most of the operate and release times in common use. The VAR position switches in the variable timer for that control. Each control has its own variable timer. Each timer has a continuously adjustable control with a scale that goes from 10 to 100. This scale is used with the X1—X10 switch to determine the duration in milliseconds. The variable timer allows a programmed duration of from 10 to 100 milliseconds.

3.8 The START A—REMOTE—START B switch is used to match the A and B controls to the make and break conditions of the output relay. Since the V—M and V—BK jacks are wired to opposite fixed contacts of the C—form relay, one jack is always make while the other is break. In the START A position, the V—M jack makes for A and breaks for B (in CALIBRATE) or breaks for 222 milliseconds (in OPERATE). In the START B position, the V—M jack makes for B and breaks for A

(in CALIBRATE) or breaks for 222 milliseconds (in OPERATE). For a description of the V—BK jack, simply interchange the words makes and breaks in the preceding description of the V—M jack.

3.9 When the START A—REMOTE—START B switch is moved to START A or START B, the TTS 75A starts to operate. Before the start, (S1, in REMOTE) the quiescent condition of the output jacks is as follows: V—M jack is open and V—BK jack is make. Immediately after the start, the V—M jack is make and the V—BK jack is break. The middle or REMOTE position of the START A—REMOTE—START B switch is used to stop the TTS 75A and return it to its quiescent (before-start) condition. The REMOTE position is also used with the TTS 75RCAE Remote Control Unit.

3.10 The RCAE has four pushbutton switches; A, B, STOP, and RLS. (See Figure 7—8). The RLS button opens the tip connection of the remote jacks. The A, B and STOP buttons are momentary action controls that duplicate the function of the START A—START B switch from a remote location.

3.11 **OPERATING PROCEDURES.**

3.12 The operating procedures described in the following paragraphs are not intended to limit the operator in using the full capabilities of the TTS 75A test set. Familiarity with the operating features described above will permit variations in procedures to accommodate known test requirements. Refer also to the simplified operating chart in Figure 3—2.

3.13 POWERING THE TEST SET.

CAUTION

Do not connect the central office battery to the power cord until the type 310 plug on the power cord is connected to the TTS 75A and do not disconnect power from the TTS 75A before disconnecting the power cord from the central office battery.

ACTION	RESULT
a. Insert type 310 plug on power cord into −48V 310 jack J3 or J4.	
b. Connect clips on other end of power cord to central office battery, tip to −48 volts and sleeve to ground with reference to the power plug in step a above.	POWER lamp DS1 lights.

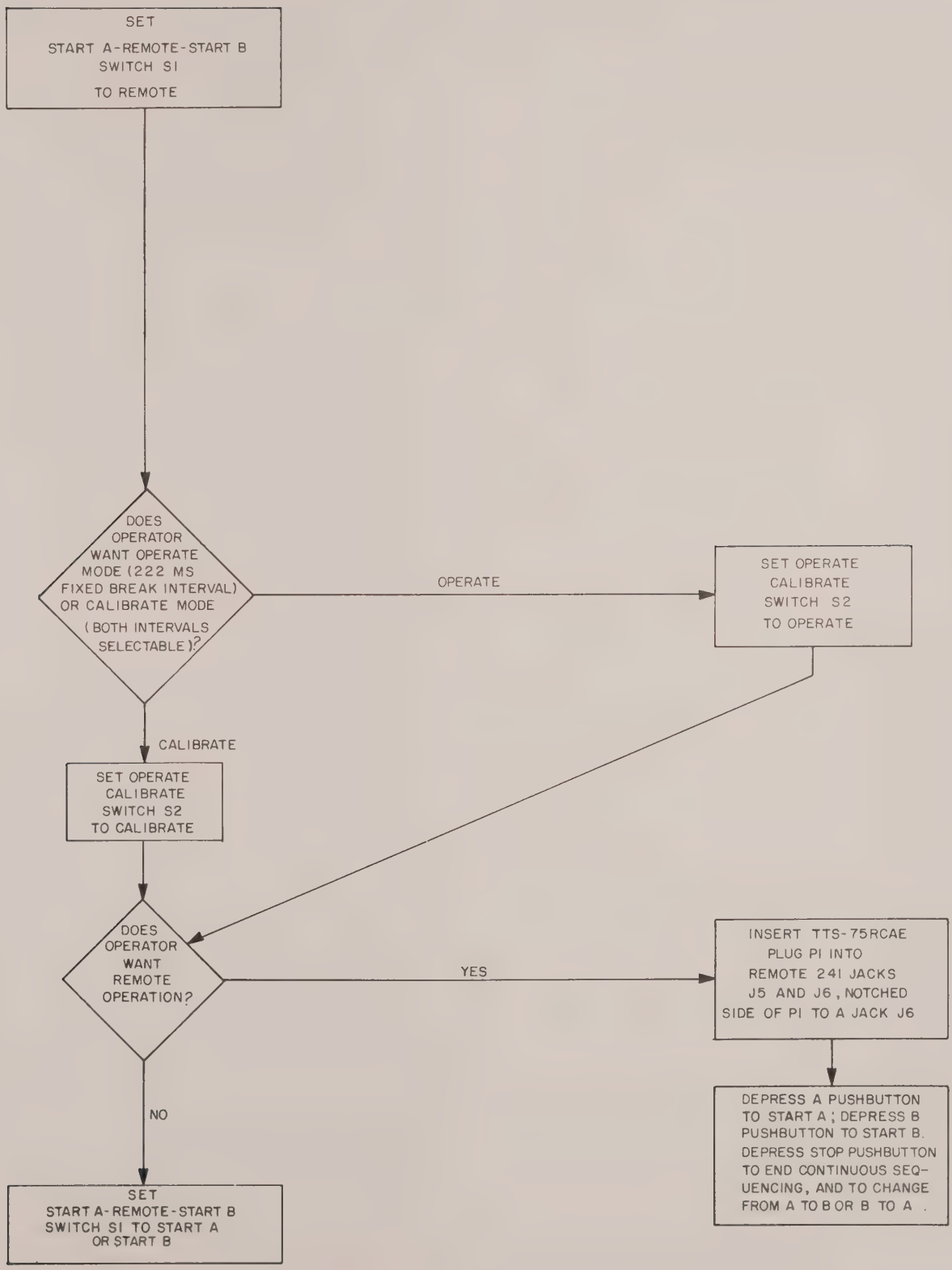


Figure 3–2. TTS 75A Simplified Operating Chart.

00515

3.14 OPERATE AND RELEASE TEST.

3.15 This test is to determine the ability of a relay to operate and release in response to a continuous sequence of dry contact make and break intervals programmed to the time durations at which the relay under test is required to operate and release. This mode of test is used to sequence a relay while making adjustments for correct operation.

ACTION	RESULT
a. Connect power as described in paragraph 3.13.	POWER lamp DS1 lights.
b. Set controls to initial position as follows: 1. START A—REMOTE—START B switch S1 to REMOTE position. 2. OPERATE CALIBRATE switch S2 to OPERATE position if release is 222 milliseconds to CALIBRATE position if release time of relay to be tested is other than 222 milliseconds. NOTE If no position of A switch S5 and B switch S6 corresponds to the required operate and release times, set both switches to the VAR position. Use A VAR 10—100 potentiometer R1 and A VAR X1 X10 switch S3 for the A time and B VAR 10—100 potentiometer R2 and B VAR X1 X10 switch S4 for the B time. 3. A switch S5 to the positon corresponding to operate time of the relay under test. 4. B switch S6 to the position corresponding to release time of the relay under test. If switch S2 is set to OPERATE in step b2 above, the position of S6 is immaterial.	
c. Connect relay under test to V—M 310 jack J2. If remote control is desired, proceed to paragraph 3.19 instead of to step d below.	
d. Set START A—REMOTE—START B switch S1 to START A position.	Relay under test should operate and release continuously.

3.16 RELEASE TIME TEST.

3.17 This test determines the ability of a relay to release (or not release) in response to a dry contact break interval programmed to the time duration at which the relay is required to release (or not release).

ACTION	RESULT
a. Connect power as described in paragraph 3.13.	POWER lamp DS1 lights.
b. Set controls to initial positions as follows: 1. START A—REMOTE—START B switch S1 to REMOTE position. 2. OPERATE CALIBRATE switch S2 to CALIBRATE position. 3. A switch S5 to position corresponding to time at which the relay under test must not release. (If desired time is not available on switch S5, refer to NOTE preceding step b3 in paragraph 3.15). 4. B switch S6 to position corresponding to time at which the relay under test must release. (If desired time is not available on switch S6, refer to NOTE preceding step b3 in paragraph 3.15).	
c. Connect relay under test to V—BR 310 jack J1. If remote control is desired proceed to paragraph 3.19 instead of steps d and e below.	Relay under test should operate and hold.
d. Set START A—REMOTE—START B switch S1 to START A position.	Relay under test should not release, since break time at jack J1 is less than release time of relay under test.
e. Set START A—REMOTE—START B switch S1 to START B position.	Relay under test should release, since break time at jack J1 is greater than release time of relay under test.

3.18 REMOTE OPERATION.

3.19 Refer to paragraphs 3.9 and 3.10. All tests may be controlled from a remote location by using the TTS 75RCAE Remote Control Unit shown in Figure 3—3.

ACTION	RESULT
a. Set START A—REMOTE—START B switch S1 to REMOTE position. b. Insert type 241 plug P1 on RCAE cord into REMOTE 241 jacks J5 and J6 on TTS 75A, with notched side toward A jack J6.	
c. Depress and release the A switch on RCAE in lieu of setting START A—REMOTE—START B switch S1 on TTS 75A to START A in paragraph 3.15, step d or paragraph 3.17, step d. NOTE Always depress STOP on RCAE before changing from A to B or vice versa.	Relay under test should perform as specified in RESULT column across from ACTION of equivalent TTS 75A front panel control in paragraph 3.15 or 3.17.

ACTION	RESULT
d. Depress and release the B switch on RCAE in lieu of setting START A—REMOTE—START B switch S1 on TTS 75A to START B in paragraph 3.17, step e. NOTE To use RCAE for switch tests requiring release of the switch, connect type 310 plug on RCAE cord to V—BR 310 jack J1 and connect circuit under test (via test cord) to the SWITCH jack J1 on RCAE unit. Depressing the RLS switch on RCAE opens the loop to the switch under test and releases the switch.	Relay under test should perform as specified in RESULT column across from ACTION of equivalent TTS 75A front panel control in paragraph 3.17.

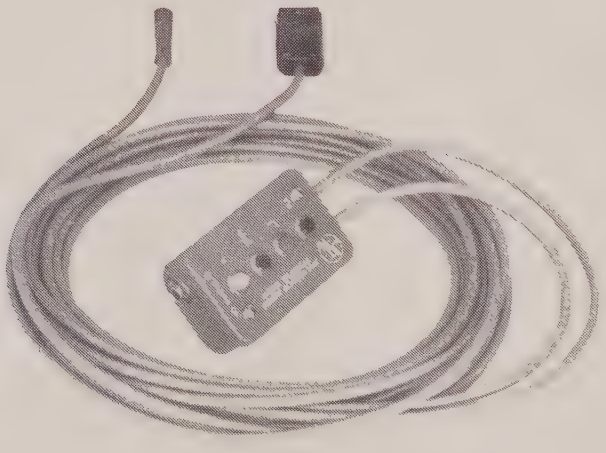


Figure 3—3. TTS 75RCAE Remote Control Unit.

SECTION 4

CIRCUIT DESCRIPTION

4.1 INTRODUCTION.

4.2 Circuit descriptions and diagrams in this section, and schematic diagrams in section 6, provide all necessary principles of operation for a thorough understanding of the TTS 75A logic and electronic functions. An overall circuit description describes the function and relationship of components and assemblies at the block diagram level. A detailed circuit description describes functions within major assemblies at the schematic diagram level.

4.3 OVERALL CIRCUIT DESCRIPTION.

4.4 Discussion of the block diagram, Figure 4—1, is based on two operating modes: calibrate and operate.

4.5 CALIBRATE MODE.

4.6 Refer to Figures 4—1 through 4—3. For the calibrate mode of relay testing, OPERATE CALIBRATE switch S2 must be set to the CALIBRATE position. The CALIBRATE position of switch S2 enables only look-at-A ($\overline{\text{LKATA}}$) and look-at-B ($\overline{\text{LKATB}}$) decoding logic in the Information Processor; the decoding logic will not recognize $\overline{222}$. Setting START A—REMOTE—START B switch S1 to the START A or START B position will start the calibrate mode of operation. Assuming START A position of S1 is selected, logic 0 ($\overline{\text{A}}$) is applied to the Information Processor, which produces a $\overline{\text{START}}$ command. Upon receipt of two 100 kHz clock pulses (CP100K), which are supplied continuously by the Preset Timer, the Information Processor applies a logic 0 (MK) to the Relay Driver. For the duration of the time interval steered by A switch S5, polar relay K1 operates; the relay makes contact across V—M 310 jack J2 and breaks contact across V—BR 310 jack J1. The $\overline{\text{LKATA}}$ command is steered by A switch S5 to the Variable Timer if S5 is set to the VAR position, or to the Diode Matrix if S5 is set to any position other than VAR. If A switch S5 is set to the VAR position, Variable Timer PC1 provides a logic 1 MS to Information Processor PC1 at the end of a time interval selected by A VAR 10—100 potentiometer R1 and A VAR X1 X10 switch S3. Upon receipt of the first CP100K following MS, the Information Processor looks at B ($\overline{\text{LKATB}}$), resets Preset Timer PC2, and applies a logic 0 (BK) to the Relay Driver. If A switch S5 is set to numbered position (50—750), Preset Timer PC2 provides a logic 1 P=C (preset complete) to the Information Processor at the end of a time interval selected at Diode Matrix PC3 (by switch S5) and applied to the Preset Timer as a 10-bit code. The first CP100K following P=C performs the same function as CP100K following MS, described above. Contacts of polar relay K1 make at J1 and break at J2 for the duration of $\overline{\text{LKATB}}$ time interval steered by B switch S6. Logic functions are as described for the $\overline{\text{LKATA}}$ interval, and the A and B intervals alternate sequentially and continuously so long as start $\overline{\text{A}}$ (or $\overline{\text{B}}$) is applied to the Information Processor. Switch S1 cannot apply $\overline{\text{A}}$ and $\overline{\text{B}}$ simultaneously. Setting switch S1 to the START B position changes the calibrate mode in one respect only: the Information processor will $\overline{\text{LKATB}}$ for the operate (MK) interval of polar relay K1 and $\overline{\text{LKATA}}$ for the release (BK) interval.

4.7 OPERATE MODE.

4.8 Refer to Figures 4—1 through 4—3. The operate mode is different from the calibrate mode in only one major respect, i.e., the A and B controls on the front panel determine time duration for only the operate (MK) interval of polar relay K1. The release (BK) interval of polar relay K1 is always 222 milliseconds in this mode of operation. For the operate mode of relay testing, OPERATE CALIBRATE switch S2 must be set to the OPERATE position. The OPERATE position of S2 enables, for the MK interval of polar relay K1, either $\overline{\text{LKATA}}$ or $\overline{\text{LKATB}}$ decoding logic in Information Processor PC1; the decoding logic will always recognize (look at) $\overline{222}$ for the BK time interval of polar relay K1. Setting START A—REMOTE—START B switch S1 to either the START A or START B position will start the operate mode in the same manner as described in paragraph 4.6 for the calibrate mode. Upon completion of the MK interval, the Information Processor decoding logic applies 0 ($\overline{222}$) directly to the 222 millisecond input line of Diode Matrix PC3. Preset Timer PC2 receives a 10-bit code for 222 milliseconds from the Diode Matrix, and provides P=C to the Information Processor when 222 milliseconds has timed out. Upon receipt of CP100K following P=C, the Information Processor terminates the BK interval and again looks at A or B via switch S5 or S6. The A or B and $\overline{222}$ intervals alternate sequentially and continuously so long as start $\overline{\text{A}}$ or $\overline{\text{B}}$ is applied to the Information Processor.

4.9 DETAILED CIRCUIT DESCRIPTION.

4.10 GENERAL.

4.11 In the following detailed circuit descriptions, both positive and negative logic symbols and names are used to indicate active states. Since each detailed description is confined to circuits applicable to the paragraph head-

ing, refer to Figure 4—1 or 6—2 for information regarding source, destination and routing of input and output logic.

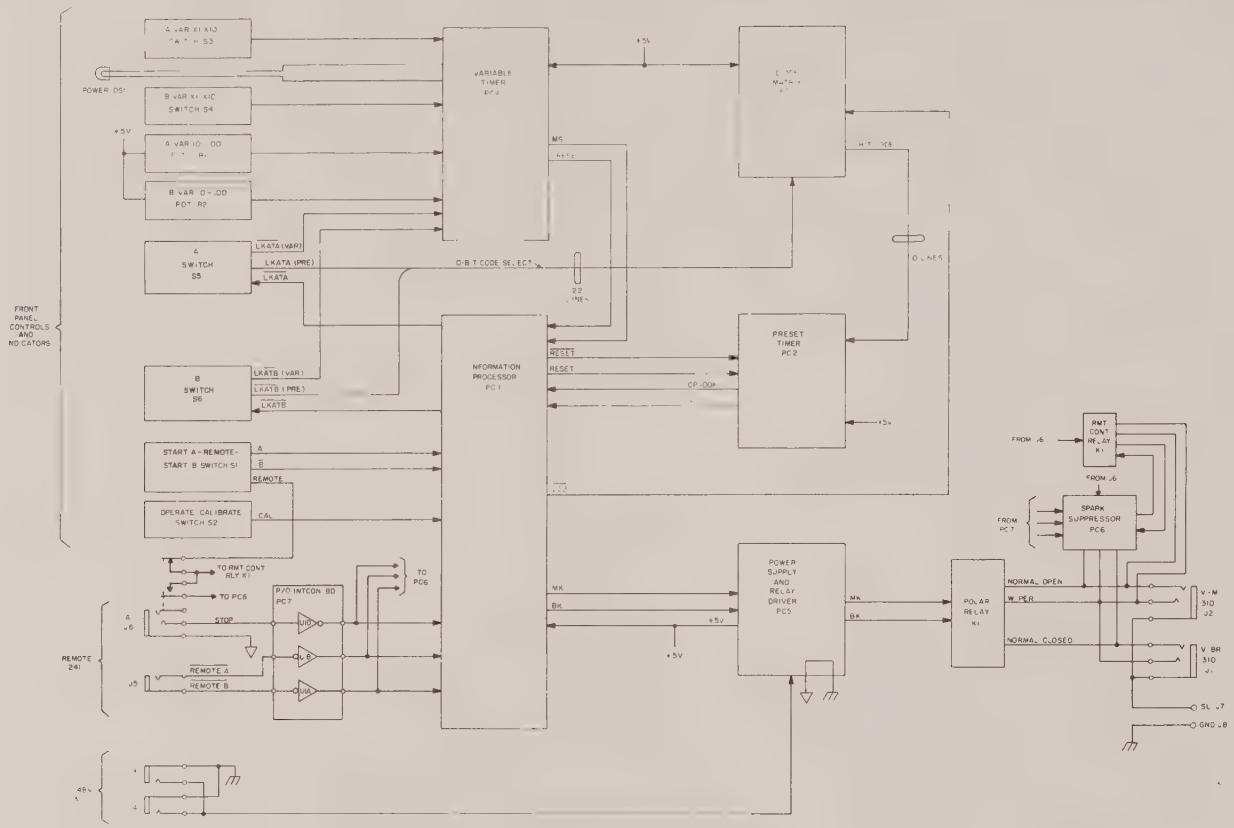


Figure 4—1. TTS 75A Overall Block Diagram.

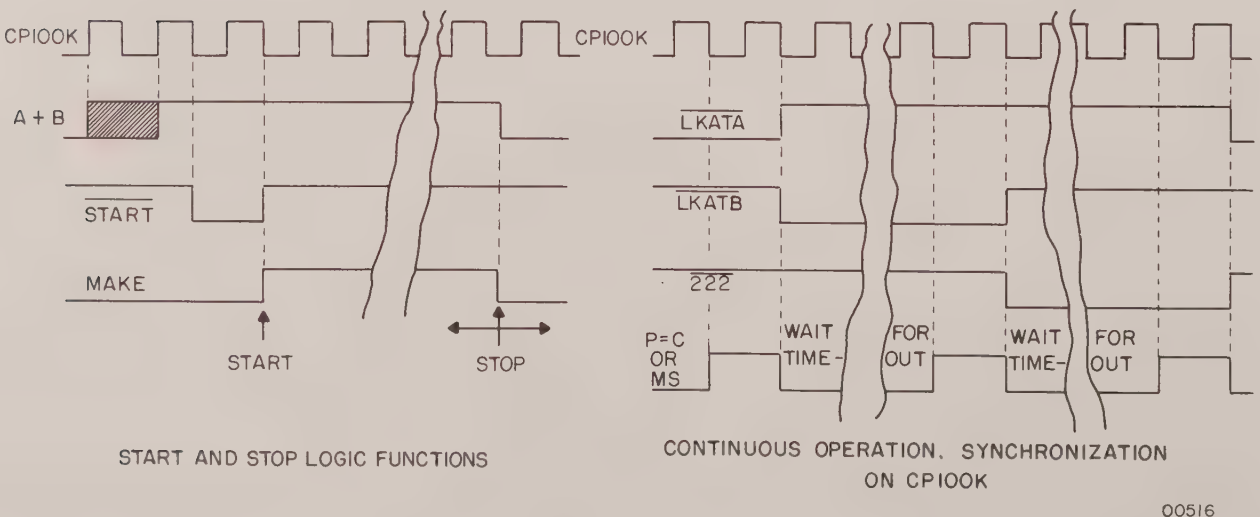


Figure 4—2. TTS 75A Synchrograms.

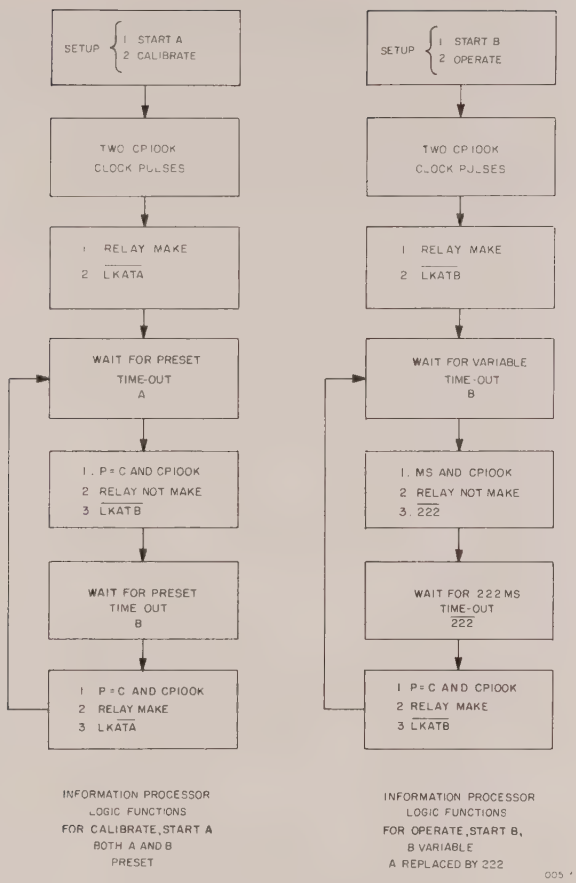


Figure 4—3. TTS 75A Information Processor, Logic Function Chart.

4.12 INFORMATION PROCESSOR.

4.13 Continuous Mode. Refer to Figure 6—4. Information Processing is enabled by +5 volts through resistor R2 to NAND gates U11B—4 and U11D—12. Logic 0 at either terminal 3 (start A) or terminal A (start B) applies logic 1 to the second input of NAND gate U11B or U11D, resulting in a logic 1 out of NOR gate U8A or U8B. If U8A provides the logic 1, decoder U1 is conditioned to produce a logic 0 ($\overline{LKATA}$) output; otherwise, U1 produces a logic 0 $\overline{LKATB}$ output. The output of U11A—3 goes to logic 1 (A + B) when the output of U8A or U8B is logic 1. The presence of A + B enables flip-flops U2A and U2B to initiate a logic 0 $\overline{START}$ command upon occurrence of the high-to-low transition of the next CP10K signal (100 kHz clock pulses supplied continously by the Preset Timer). A + B also enables relay control flip-flop U4B and preset timing reset flip-flop U4A. During the high-to-low transition of the next CP100K after A + B, both inputs to OR gate UA are logic 1, since the $\overline{START}$ command is going from low to high. The logic 1 from U5A, clocks U4B to provide a logic 0 MK command for the time-out interval being "looked at" by decoder U1. Upon expiration of the make interval, P = C at U6A—1 or MS at U6C—10 becomes logic 1 and U4B is clocked by CP100K to provide a logic 0 BK command for time-out of the break interval being "looked at" by decoder U1. One output from U4B, either MK or BK, is logic 0 at all times. If the level at U1—13 is logic 1 (calibrate mode) U1 will always look at the break interval as determined by input at U1—14. If logic 0 appears at U1—13, U1 will always produce logic 0 ($\overline{222}$) for the break interval. Upon expiration of the break interval, P = C or MS will again appear and enable U4B to be clocked; the make and break intervals will sequence continuously so long as both inputs of either U11B or U11D are at logic 1. For remote control of the Information Processor, a logic 0 $\overline{STOP}$ input at OR gate U5D—13 clears remote start flip-flops U9A and U9B. The $\overline{STOP}$ input is at logic 0 only when the STOP button on the TTS 75RCAE unit is depressed. When one of these flip-flops is clocked by logic 1 at U9A—3 (RA) or U9B—11 (RB), the $\overline{Q}$ output goes low and produces a logic 1 out of U8A (SA) or U8B (SB) to start the make/break sequencing. Sequencing continues until $\overline{STOP}$ again appears at U5D—13.

4.14 DIODE MATRIX.

4.15 Refer to Figure 6—8. Input logic levels to the Diode Matrix circuit originate as $\overline{LKATA}$, $\overline{LKATB}$, and $\overline{222}$; all of which come from the Information Processor. $\overline{LKATA}$ and $\overline{LKATB}$ are steered to the matrix by preset switches S5 and S6, respectively, and $\overline{222}$ is received directly from the Information Processor. Only one input to the matrix will be logic 0 at any given time. $\overline{LKATA}$ and $\overline{LKATB}$ may appear on any matrix line except 222 (terminal Z), which is exclusive to the $\overline{222}$ input. Outut logic levels from the matirx provide a 10-bit binary code that represents a preset time interval in milliseconds to the selected matrix input line. Table 4—1 defines the 10-bit binary coded output and the preset interval for each of 24 possible matrix line conditions, including the condition for no preset interval.

4.16 PRESET TIMER.

4.17 Refer to Figure 6—6. Crystal-controlled oscillator U10A/B generates a 10-megahertz signal into divide-by-ten circuits U1, U2, U3, and U4. A 100-kilohertz pulse train at the output of U2 provides CP100K for synchronizing the Information processor and the Variable Timer. The 10-bit counter consisting of U5, U6A—B and U7 counts 1-kilohertz pulses (equivalent to 1-millisecond intervals) from divider U4, and the intervals are compared to a preset time interval in comparator U8 and U9. When the intervals counted by U5 and U7 equal the preset interval applied to U8 and U9, P = C at the output of inverter U10D goes to logic 1. Since the preset interval in U8 and U9 is the 10-bit binary code being looked

at by the Information Processor, P=C indicates completion of the desired time interval. The RESET and $\overline{\text{RESET}}$ inputs, which initiate the counter each time a preset time interval is required, ensure accuracy of the comparison. Inverter U10C detects an over-count condition, which may occur when preset switch S5 or S6 is adjusted during sequencing, and forces a P=C signal.

4.18 VARIABLE TIMER.

4.19 The function of the variable timer board (Figure 6—10) is to generate the A and B times under control of the A and B variable potentiometers and the X1-X10 switches.

4.20 When the unit is being operated in the preset mode, pins 1 and 2 are open. This allows pull-up resistors R5 and R6 to generate logic 1 levels. These are inverted by U7A and U7B to logic 0. This results in a logic 1 at the output of U7C as long as the unit is in the preset mode. This inhibits the output of the variable timer board and allows the preset timer to take control.

4.21 Astable multivibrators U8 and U9 generate the basic frequencies used to create the A and B timing required. The free-running frequency of U8, for example, is determined by C3, R3, R7, and VAR A potentiometer R1. The multivibrator outputs are steered through U6A and U7D by $\overline{\text{LKATA}}$ and $\overline{\text{LKATB}}$. These are complementary inputs so that only one multivibrator output can be selected at a time.

4.22 Either the A or B astable output is applied through U6B to decade counters U2 and U3. Pin 12 of U2 is connected to gate U1D for use as the X1 source and U3 pin 12 to U1C for the X10 source.

4.23 The A and B times can be X1 or X10 independent of each other. This is accomplished by using the $\overline{\text{LKATA}}$ and $\overline{\text{LKATB}}$ inputs and the A and B X1-X10 switches to control gates U4A—C, U6C, U6D, and U1A—D. Assuming it is time to generate the A time, the following conditions exist. $\overline{\text{LKATA}}$ is a logic 0 and $\overline{\text{LKATB}}$ is a logic 1. $\overline{\text{LKATA}}$ enables U7D while $\overline{\text{LKATB}}$ inhibits U6A. This allows the output of U8 to be passed by U7D and U6B to the decade dividers. The $\overline{\text{LKATA}}$ level is inverted by U7B and, along with the logic 1 at $\overline{\text{LKATB}}$, enables two inputs of U4B. $\overline{\text{LKATA}}$ inhibits U4A. Assuming A X1-X10 switch S3 is in the X1 position, the third input to U4B is a logic 0 and the gate output is a logic 1. With the output of U4A at logic 1, both inputs to U6D are now logic 0 to generate a logic 1 output. This enables one input of U1D while the output of U2 is allowed to pass through U1D and U1A to the final divider, U5. When the X10 function is desired, the chain of gates will inhibit U1D and allow the X10 output of U3 to be passed by U1C. In a similar manner, the complements of $\overline{\text{LKATA}}$ and $\overline{\text{LKATB}}$ will generate the B time.

4.24 The final output stage is connected as a divide-by-three stage. Assuming that U5 has just been reset, the MS output transitions from a logic 1 to a logic 0. After three negative transitions at U5—1, MS again goes to a logic 1. Through a series of logic gates on the information processor board, a positive reset pulse appears at pin 12 to reset U5 to a count of 9. The time between the leading edges of the two pulses at MS is the desired time.

4.25 POWER SUPPLY AND RELAY DRIVER.

4.26 Power Supply. Refer to Figure 6—12. Central office battery voltage is dropped by zener diodes CR9 and CR10 and regulated to a nominal 33 volts dc by Darlington transistor Q7. High-frequency multivibrator Q2 and Q3, operating at 25 to 50 kHz, converts the 33 volts dc to an ac voltage, which is applied through power switching transistors Q1, Q4, Q5 and Q6 to a high-frequency step-down transformer. Output from the transformer (7V ac) is full-wave rectified, filtered and smoothed to +5 volts dc for distribution to integrated circuits used throughout the TTS 75A. Potentiometer R12 is provided to adjust the 5-volt output by raising or lowering the 33-volt input to the inverter circuit. Zener diode CR7 prevents damage to integrated circuits in the event of catastrophic failure of power supply components.

4.27 Relay Driver. Refer to Figure 6—12. Optic couplers U1 and U2 convert low level MK and BK signals from the Information Processor to high level currents. The optic couplers also provide isolation and voltage inversion. Transistors Q8 and Q9 and diode CR11 protect the optic coupler transistors.

4.28 REMOTE CONTROL INTERFACING.

4.29 Refer to Figure 6—15. Three Schmitt triggers, U1A, U1B and U1D, are used to eliminate contact bounce from three momentary pushbutton switches on the RCAE remote control unit (Figure 6—17) on the front panel. The Schmitt triggers are located on the Interconnection Board in the TTS 75A.

4.30 POLAR RELAY AND SPARK SUPPRESSOR.

4.31 Refer to Figure 6—2. For positive contact control and fast switching speed at V—BR jack J1 and V—M jack J2, polar relay K1 has a split coil with magnetic polarization. Spark suppressors on PC6 are connected across the make and break contacts of relay K1 to prolong contact life. Gas discharge protectors RV1 and RV2 break down at 90 volts to prevent arcing across the contacts of polar relay K1. Circuit board PC6 also contains transistors Q1, Q2 and Q3, which operate remote control relay K1 to control V—M jack J2 tip and ring during remote operation.

Table 4—1. Diode Matrix Reference Chart.

Preset Interval (Milli-seconds)	Matrix Line at Logic 0 (GND)	10-Bit Binary Coded Output (Logic 0 = 0.2V, Logic 1 = 4V)									
		P0	P1	P2	P3	P4	P5	P6	P7	P8	P9
50	N	0	1	0	0	1	1	0	0	0	0
55	F	1	1	1	0	1	1	0	0	0	0
62	J	0	1	1	1	1	1	0	0	0	0
70	R	0	1	1	0	0	0	1	0	0	0
80	L	0	0	0	0	1	0	1	0	0	0
90	D	0	1	0	1	1	0	1	0	0	0
100	6	0	0	1	0	0	1	1	0	0	0
111	B	1	1	1	1	0	1	1	0	0	0
125	5	1	0	1	1	1	1	1	0	0	0
140	4	0	0	1	1	0	0	0	1	0	0
155	3	1	1	0	1	1	0	0	1	0	0
175	2	1	1	1	1	0	1	0	1	0	0
200	V	0	0	0	1	0	0	1	1	0	0
225	15	1	0	0	0	0	1	1	1	0	0
250	X	0	1	0	1	1	1	1	1	0	0
275	16	1	1	0	0	1	0	0	0	1	0
300	Y	0	0	1	1	0	1	0	0	1	0
333	17	1	0	1	1	0	0	1	0	1	0
375	18	1	1	1	0	1	1	1	0	1	0
450	19	0	1	0	0	0	0	1	1	1	0
500	20	0	0	1	0	1	1	1	1	1	0
750	21	0	1	1	1	0	1	1	1	0	1
222	Z	0	1	1	1	1	0	1	1	0	0
None	None	0	0	0	0	0	0	0	0	0	0

SECTION 5

MAINTENANCE AND CALIBRATION

5.1 INTRODUCTION.

5.2 Information on preventive maintenance, trouble analysis, and calibration is provided in this section. Necessary test equipment is listed and described. Maintenance, calibration and repair should be performed by personnel who are familiar with the purpose and operation of the TTS 75A, and who have adequate facilities for repairing digital electronics.

5.3 TEST EQUIPMENT REQUIRED.

5.4 The following items of test equipment are required for maintenance and calibration of the TTS 75A.

a. Oscilloscope with a minimum sensitivity of 100 mv/cm at 15 MHz.

b. Voltmeter with minimum impedance of 40,000 ohms and accuracy of 1%.

c. Logic probe for +5V dc logic.

d. Ohmmeter for continuity checks.

5.5 ROUTINE PREVENTIVE MAINTENANCE.

5.6 FRONT PANEL JACKS.

5.7 Adjust and clean spring contacts as necessary for good electrical connections. The hinged front panel of the test set is opened by removing two screws from the left side of the panel.

5.8 FRONT PANEL SWITCHES.

5.9 Inspect wipers of A and B preset switches S5 and S6 for wear and dirt. Use a contact cleaner as necessary to ensure good electrical connections.

5.10 TROUBLE ANALYSIS.

5.11 Operate the TTS 75A and check for symptoms of malfunction as described by the user. Use the information in Table 5—1 and paragraphs 5.12 through 5.24 to isolate the trouble.

Table 5—1. Symptom Reference List.

SYMPTOM	PROBABLE LOCATION OF FAULT
No +5V Power	33V preregulator or multivibrator on PC5. IC failure on any other circuit board.
Non-operating polar relay	Optic couplers on Power/Driver board; U3 on Cp1; U10 on PC2; open wiper on either preset switch (S5 or S6).
Incorrect time durations	Diode or transistor on PC3; capacitor or IC on Variable Timer board PC4; potentiometer R1 or R2 on front panel; divider chain on PC2.
RCAE accessory inoperative or intermittent	U1 on PC7; Q1, Q2 or Q3 on PC6; remote control relay K1; front panel jack J5 of J6; RCAE pushbuttons; U9 on PC1.
Any of the front panel controls inoperative	PC1; U1 on PC7; specific front panel control.
Polar relay K1 has reduced contact life	Check spark suppressors RV1 and RV2 on PC6.

5.12 INFORMATION PROCESSOR PC1.

5.13 Repairs to PC1 should be made by Northeast Electronics or other adequately equipped digital electronics repair facility. Replacement cards are available from Northeast Electronics.

5.14 PRESET TIMER PC2.

5.15 Same as for PC1 in paragraph 5.13.

5.16 DIODE MATRIX PC3.

5.17 Refer to the schematic diagram, Figure 6—8, and to Table 4—1. If all preset intervals are incorrect, suspect Preset Timer PC2. If one preset time interval is incorrect, look for an open or shorted diode in the matrix input line associated with the incorrect output code. If several or most preset intervals are incorrect, look for a defective diode-transistor output circuit. By stopping the TTS 75A and connecting a grounding strap to the input line(s) associated with the incorrect interval(s), the logic probe (paragraph 4.5c) may be used at the 10 output lines to compare actual output to the output specified in Table 4—1.

5.18 VARIABLE TIMER PC4

5.19 Refer to the schematic diagram, Figure 6—10. If all variable intervals are incorrect, as measured by oscilloscope at MK or BK post on PC5, suspect U4, U6, U1 or U5 on PC4. Operate X1 X10 switches S3 and S4 to check timing capacitors C5 and C3. With vertical and external trigger inputs of oscilloscope connected to MS output of PC4, look for transitions as the TTS 75A is operated with A and B intervals alternately variable and preset. This will determine which of the two timing circuits (U8 or U9) in the Variable Timer is defective. Also operate A and B potentiometers R1 and R2 on the front panel through full range to ensure correct timing at all settings.

5.20 POWER SUPPLY AND POLAR RELAY DRIVER PC5.

5.21 Power Supply. Refer to Figure 6—12. Conventional troubleshooting with an oscilloscope will isolate the faulty component. Note that if multivibrator Q2/Q3 fails, drivers Q5 and Q6 (mounted on base plate) are both off. However, if one driver fails, secondary breakdown due to high current will destroy the other. Note also that at the multivibrator frequency (25-50 kHz) a short on the +5V output will not harm the drivers, but will put a heavier load on preregulator Q7; the power dissipated as heat in the card cage cover comes from Q7. If the +5V line is noisy because of dissymmetry of faulty filtering, the storage circuits on PC1 or PC2 will operate unpredictably. Check for time symmetry of multibibrator output, and for symmetry of transformer secondary output. Check for a noise level of less than 50 millivolts on the +5V dc line.

5.22 Polar Relay Driver. Refer to Figure 6—12. If polar relay K1 does not make and break but correct MK and BK transitions do appear at the input to optic couplers U1 and U2, check the MK and BK output (approximately 24V dc) from Q8 and Q9 to determine which circuit is defective. Isolate the fault further by checking for voltage transitions between the optic couplers and protective transistors Q8 and Q9.

5.23 REMOTE INTERFACING.

5.24 Refer to Figures 6—2, 6—15 and 6—16. Control functions from the TTS 75RCAE Remote Control Unit are interfaced with the Information Processor through three Schmitt triggers in IC U1 on Interconnection Board PC7. The output of these triggers may be checked with a logic probe while depressing and releasing the associated RCAE pushbutton switch. Check continuity through RCAE switches when depressed before assuming the Schmitt triggers are defective.

5.25 CALIBRATION PROCEDURE.

5.26 Power Supply. The power supply on PC5 may require a periodic adjustment. This adjustment is made by connecting a voltmeter across the +5V dc quick-disconnects labeled V and G on Interconnection Board PC7, or across the ~~+5V~~ 14.88 dc posts on PC1. If the level is not ~~+5~~ 14.88 ± 1%, adjust potentiometer output at ~~+5V~~ 14.88 dc ± 1%.

SECTION 6

DIAGRAMS

6.1 INTRODUCTION.

6.2 Figures 6—1 through 6—17 are the assembly and schematic diagrams for the TTS 75A and the TTS 75RCAE.

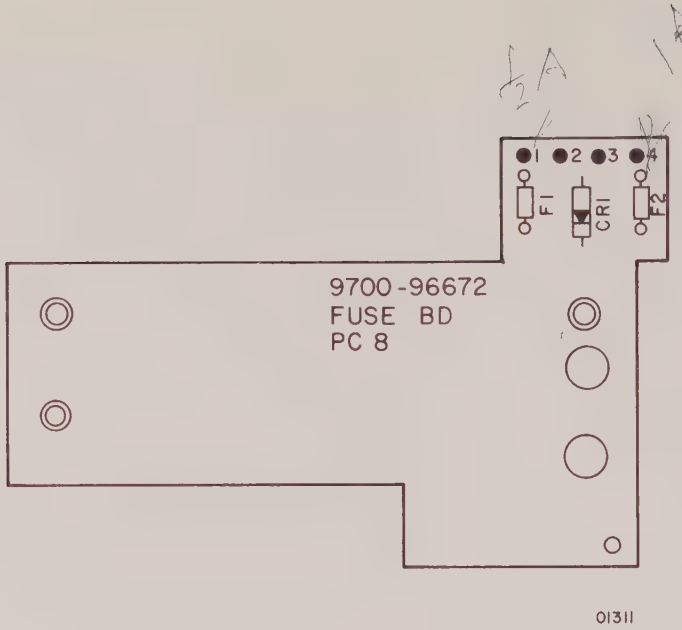


Figure 6—1. Fuse Board PC8 (96672) Component Location.

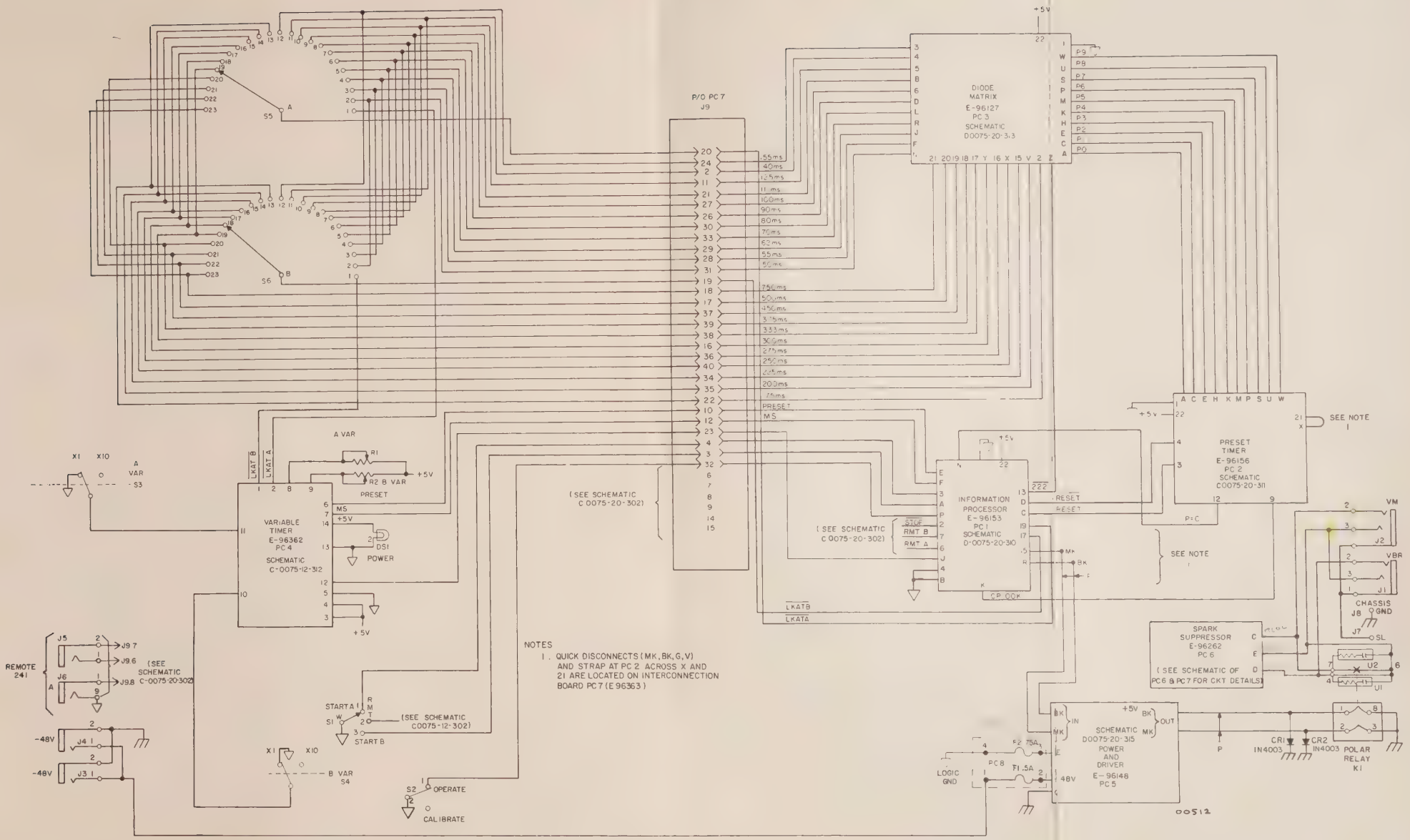

DIODE MATRIX E-96127 PC 3 SCHEMATIC D0075-20-313
P/O PC 7 J9
PRESET TIMER E-96156 PC 2 SCHEMATIC C0075-20-311
SEE NOTE 1
INFORMATION PROCESSOR E-96153 PC 1 SCHEMATIC D-0075-20-310
(SEE SCHEMATIC C 0075-20-302)
VARIABLE TIMER E-96362 PC 4 SCHEMATIC C-0075-12-312
A VAR
B VAR
PRESET
POWER
SPARK SUPPRESSOR E-96262 PC 6
(SEE SCHEMATIC OF PC 6 & PC 7 FOR CKT DETAILS)
SCHEMATIC D0075-20-315 POWER AND DRIVER E-96148 PC 5
POLAR RELAY K1
CHASSIS GND
REMOTE 241
LOGIC GND
OPERATE
CALIBRATE
START A
START B
NOTES
1. QUICK DISCONNECTS (MK, BK, G, V) AND STRAP AT PC 2 ACROSS X AND 21 ARE LOCATED ON INTERCONNECTION BOARD PC 7 (E 96363)
00512

Figure 6—2. TTS 75A Interconnection Diagram.

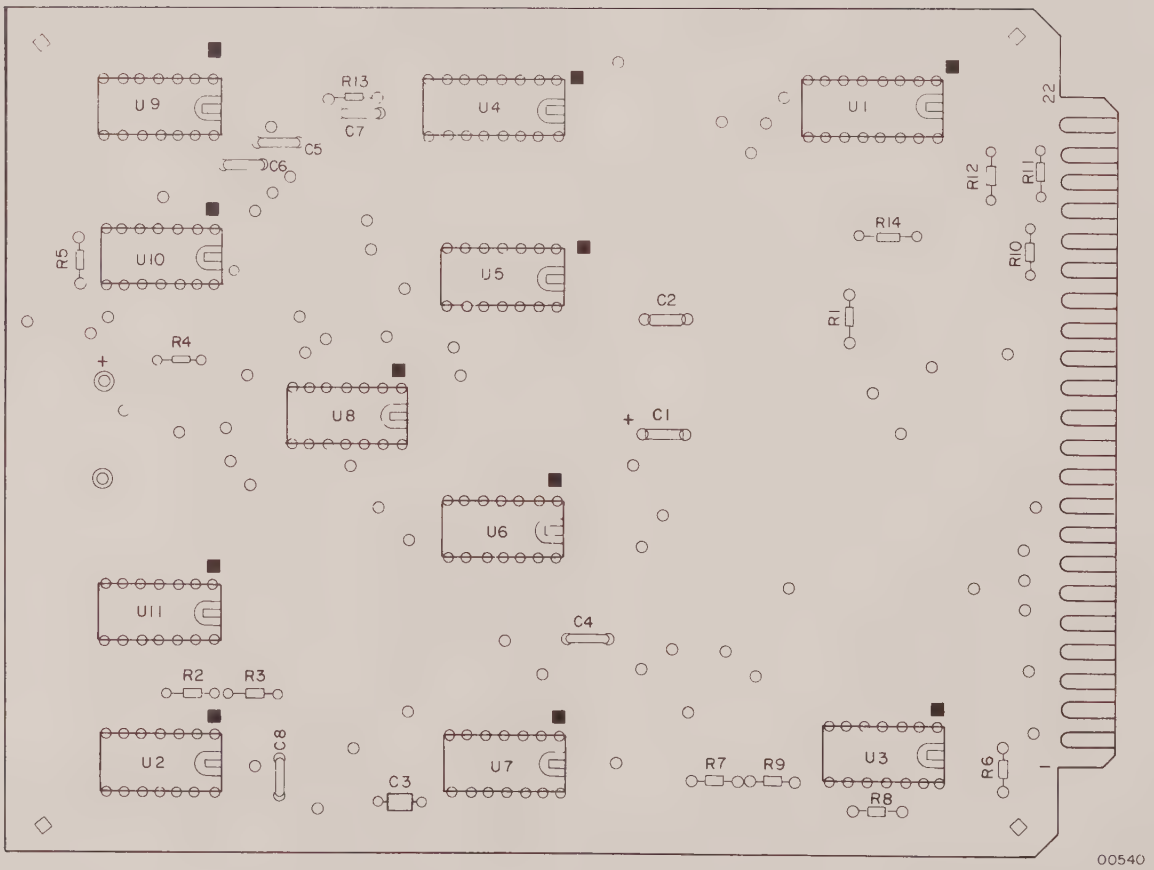
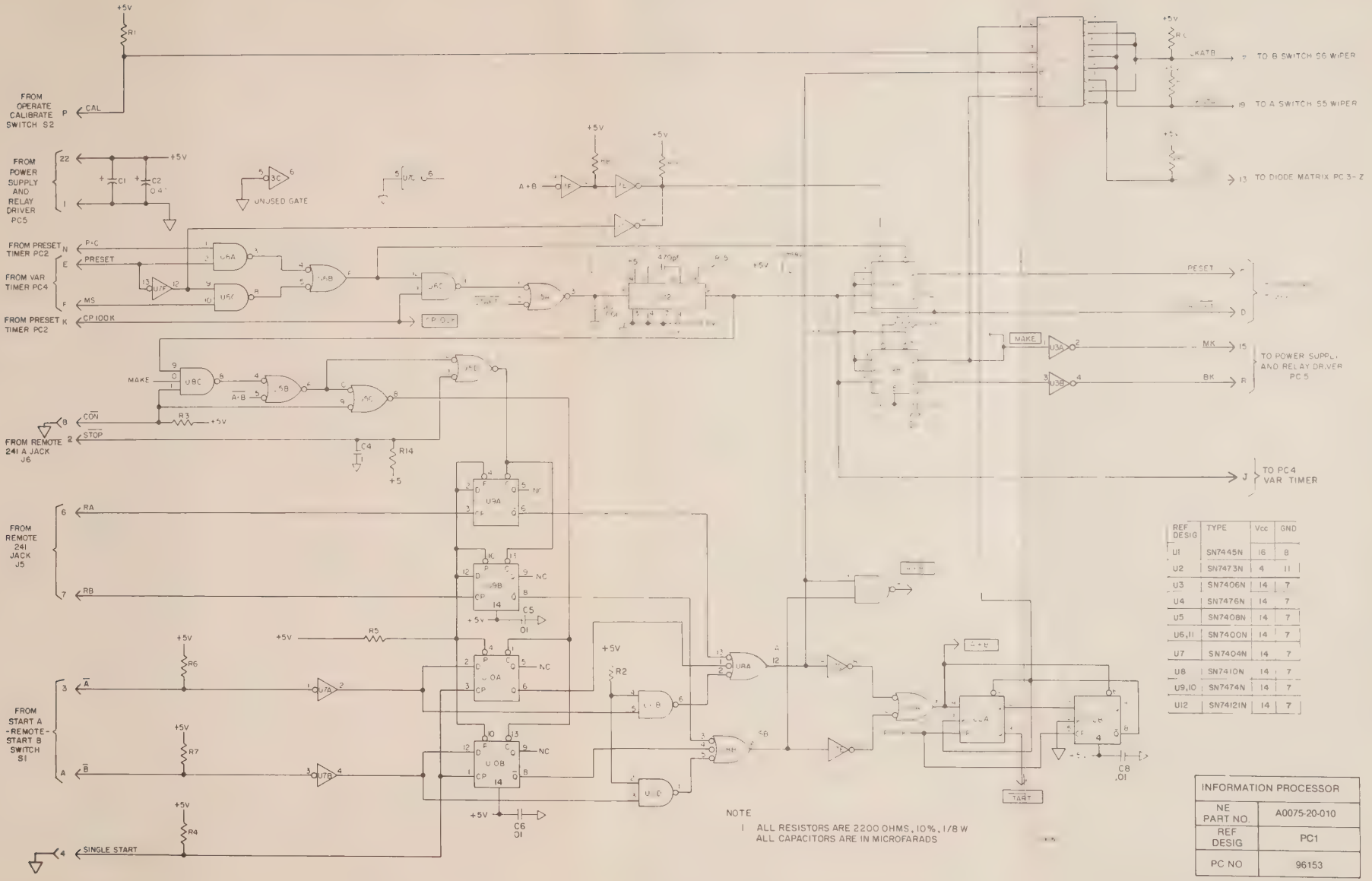


Figure 6—3. Information Processor PC1 (96153) Component Location.



REF DESIG	TYPE	Vcc	GND
U1	SN7445N	16	8
U2	SN7473N	4	11
U3	SN7406N	14	7
U4	SN7476N	14	7
U5	SN7408N	14	7
U6,11	SN7400N	14	7
U7	SN7404N	14	7
U8	SN7410N	14	7
U9,10	SN7474N	14	7
U12	SN74121N	14	7

INFORMATION PROCESSOR	
NE PART NO.	A0075-20-010
REF DESIG	PC1
PC NO	96153

Figure 6—4. Information Processor PC1, (96153) Schematic Diagram.

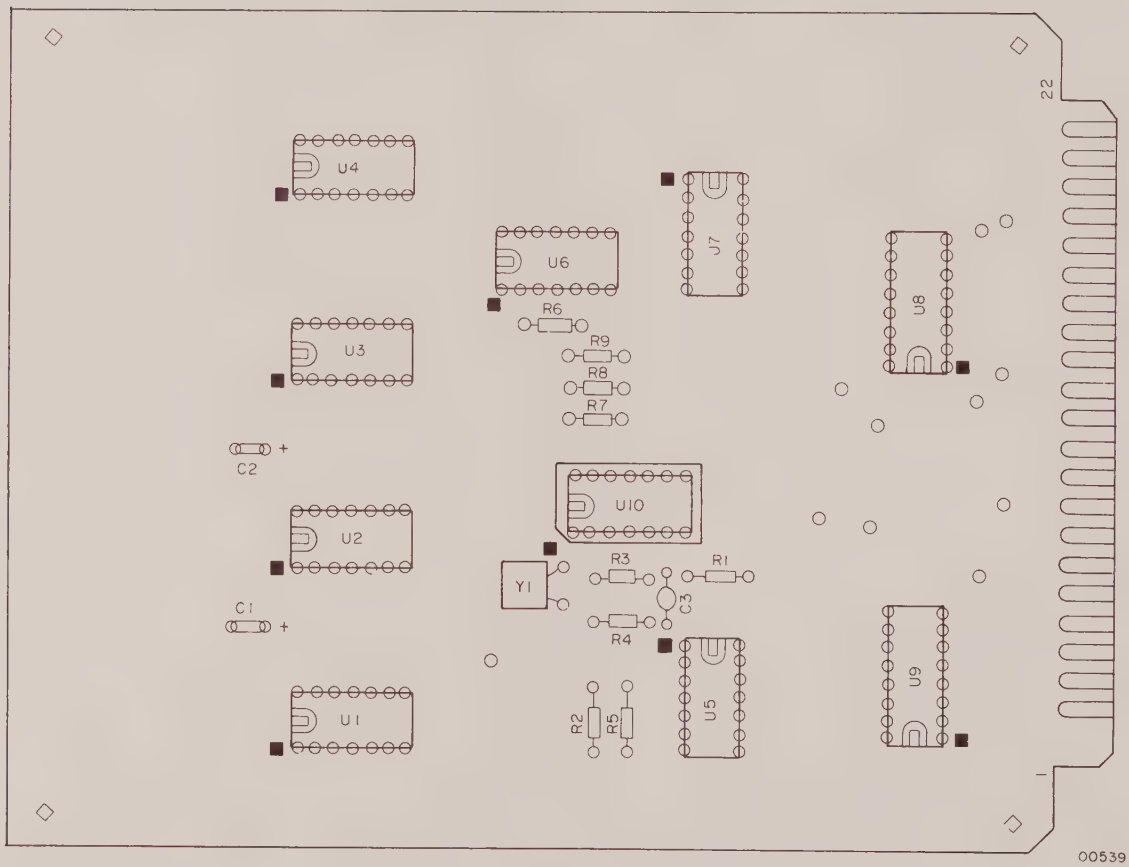
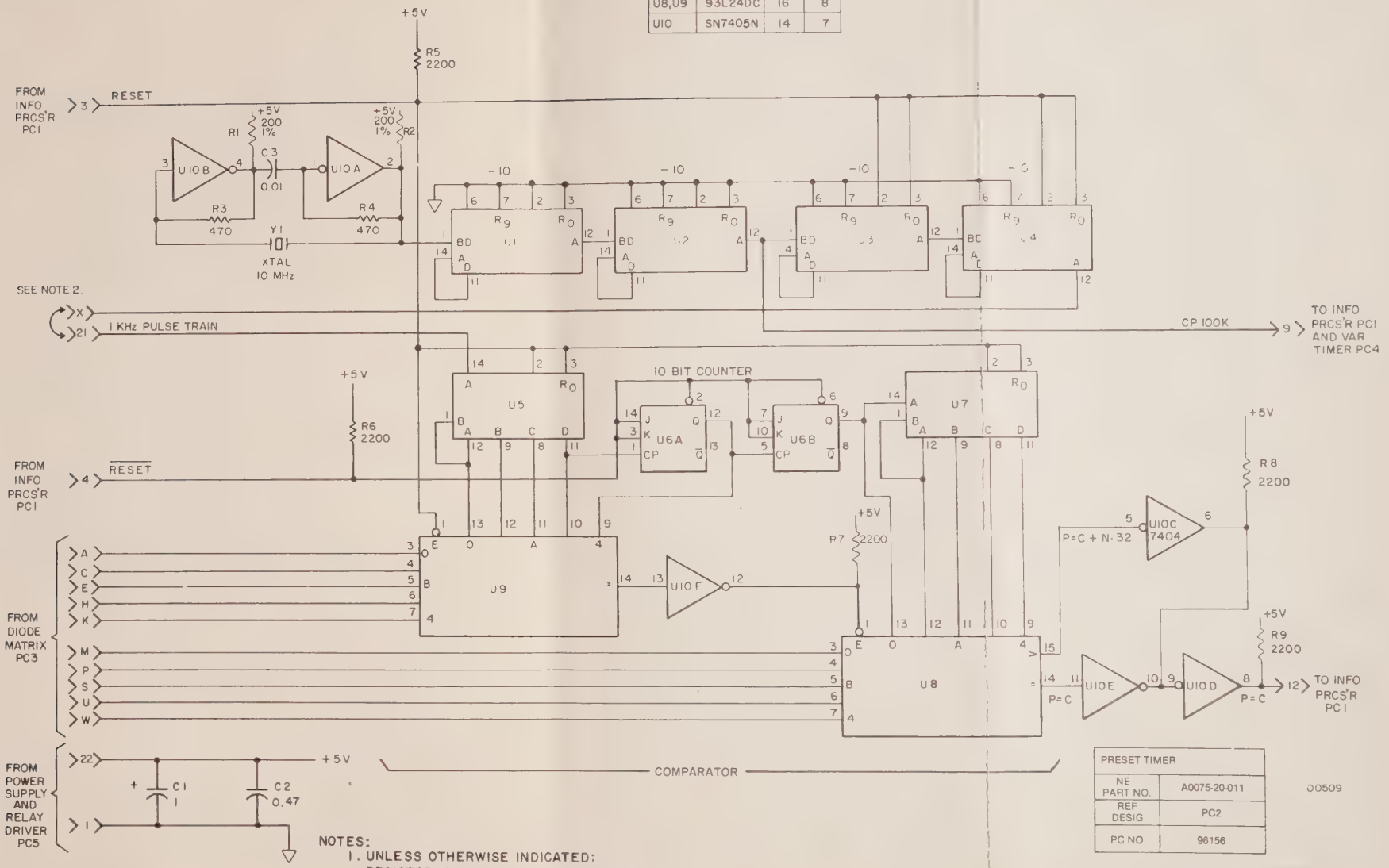


Figure 6—5. Preset Timer Circuit Board PC2 (96156) Component Location.

REF DESIG	TYPE	Vcc	GND
U1-U4	SN7490AN	5	10
U5, U7	SN7493AN	5	10
U6	SN7473N	4	11
U8, U9	93L24DC	16	8
U10	SN7405N	14	7



NOTES:
1. UNLESS OTHERWISE INDICATED:
   RESISTOR VALUES ARE IN OHMS, 10%, 1/8 W
   CAPACITOR VALUES ARE IN MICROFARADS.
   INDUCTANCE VALUES ARE IN MILLIHENRYS.
2. STRAP SHOWN LOCATED ON E-96363, PC7.
3. U10 IS AN SN7405 FOR 10MHZ OPERATION.

PRESET TIMER	
NE PART NO.	A0075-20-011
REF DESIG	PC2
PC NO.	96156

00509

Figure 6–6. Preset Timer PC2, (96156) Schematic Diagram.

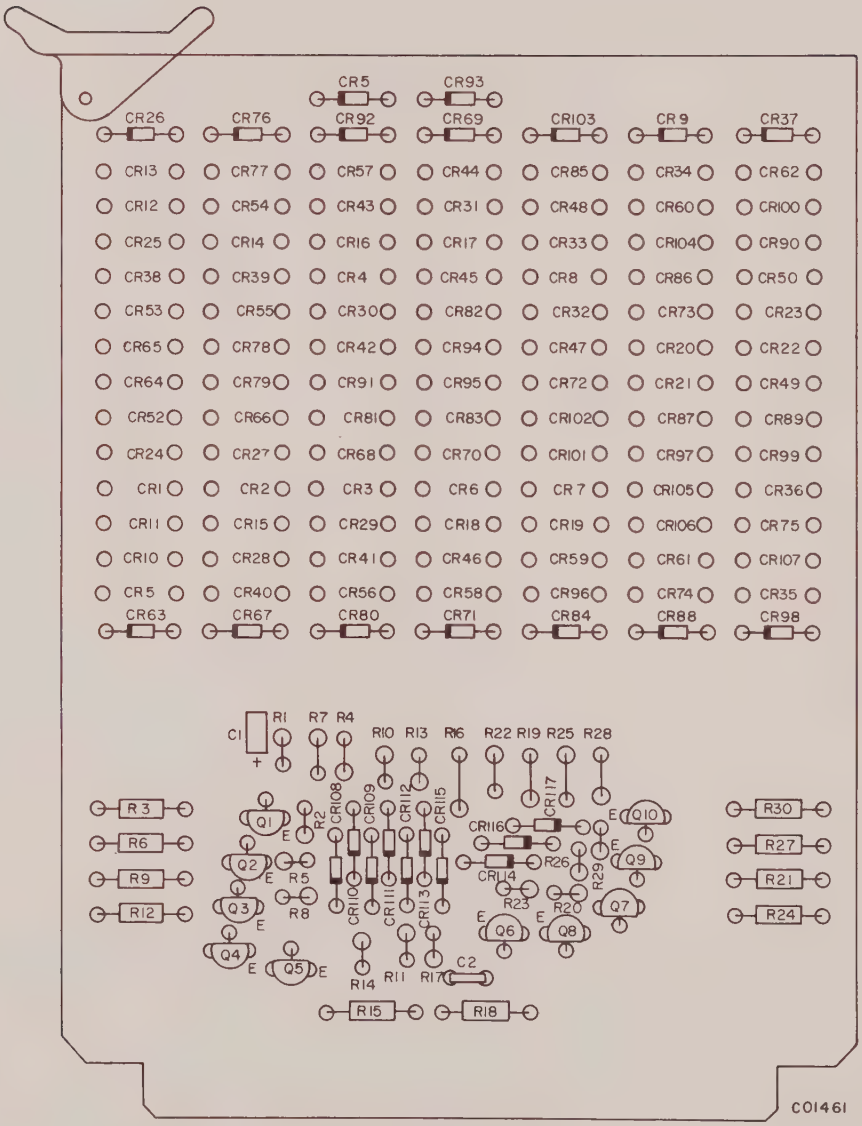


Figure 6—7. Diode Matrix Circuit Board PC3 (96127) Component Location.

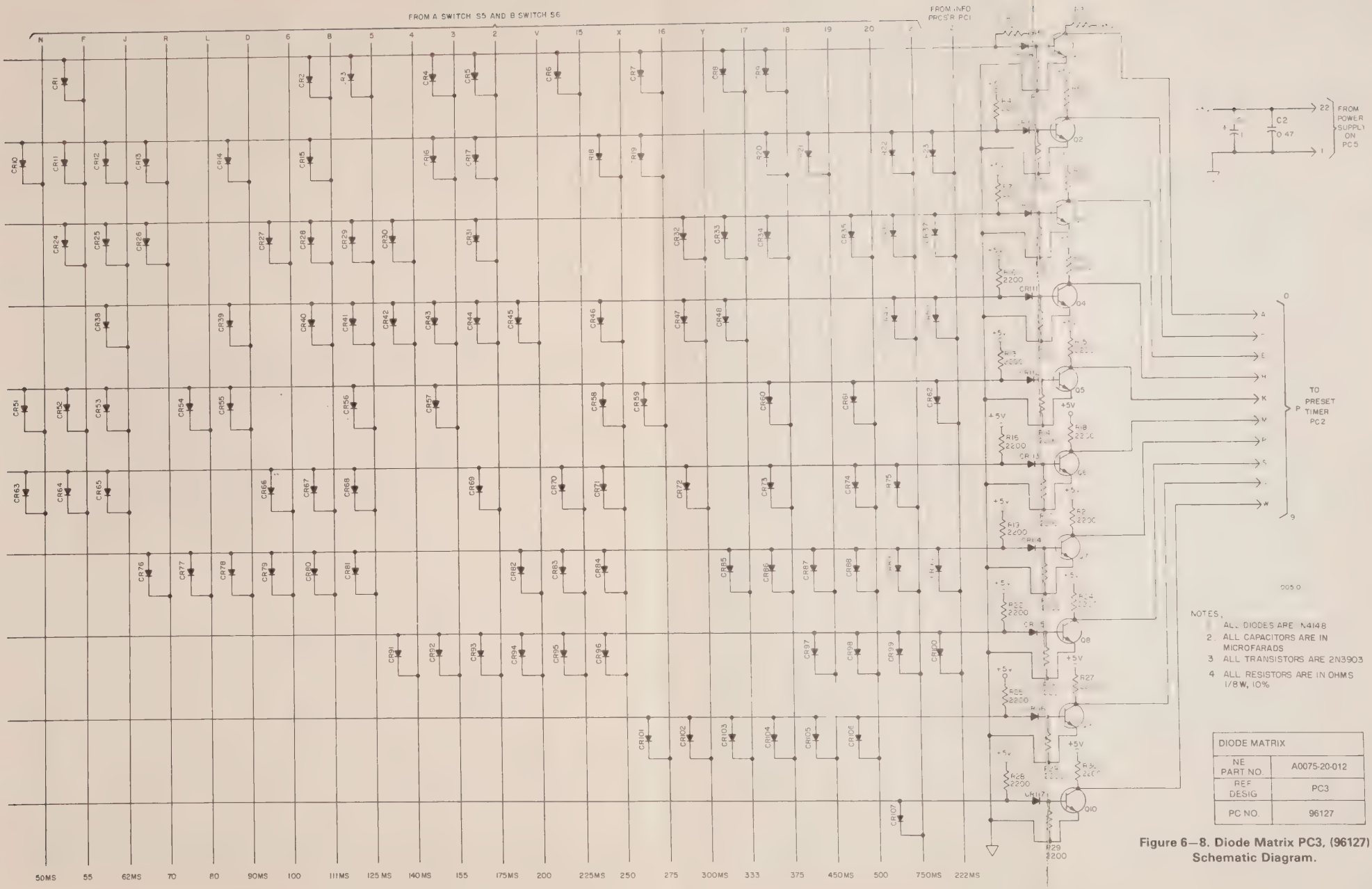

FROM A SWITCH S5 AND B SWITCH S6
FROM INFO PROC'R PC1
TO PRESET TIMER PC2
FROM POWER SUPPLY ON PC5
NOTES:
1. ALL DIODES ARE IN4148
2. ALL CAPACITORS ARE IN MICROFARADS
3. ALL TRANSISTORS ARE 2N3903
4. ALL RESISTORS ARE IN OHMS 1/8W, 10%
DIODE MATRIX
NE PART NO. A0075-20-012
REF DESIG PC3
PC NO. 96127
50MS 55 62MS 70 80 90MS 100 111MS 125MS 140MS 155 175MS 200 225MS 250 275 300MS 333 375 450MS 500 750MS 222MS

Figure 6—8. Diode Matrix PC3, (96127) Schematic Diagram.

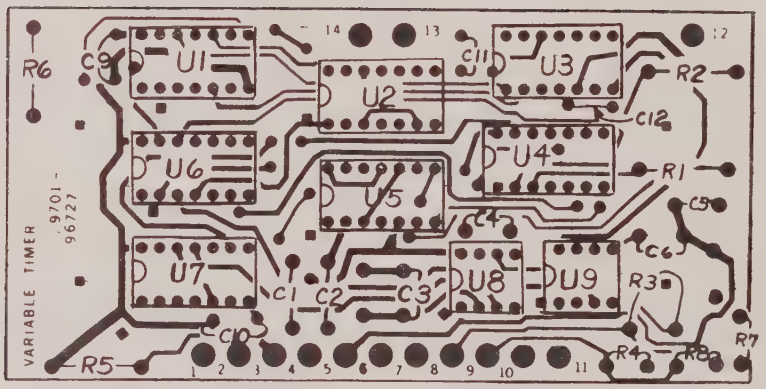
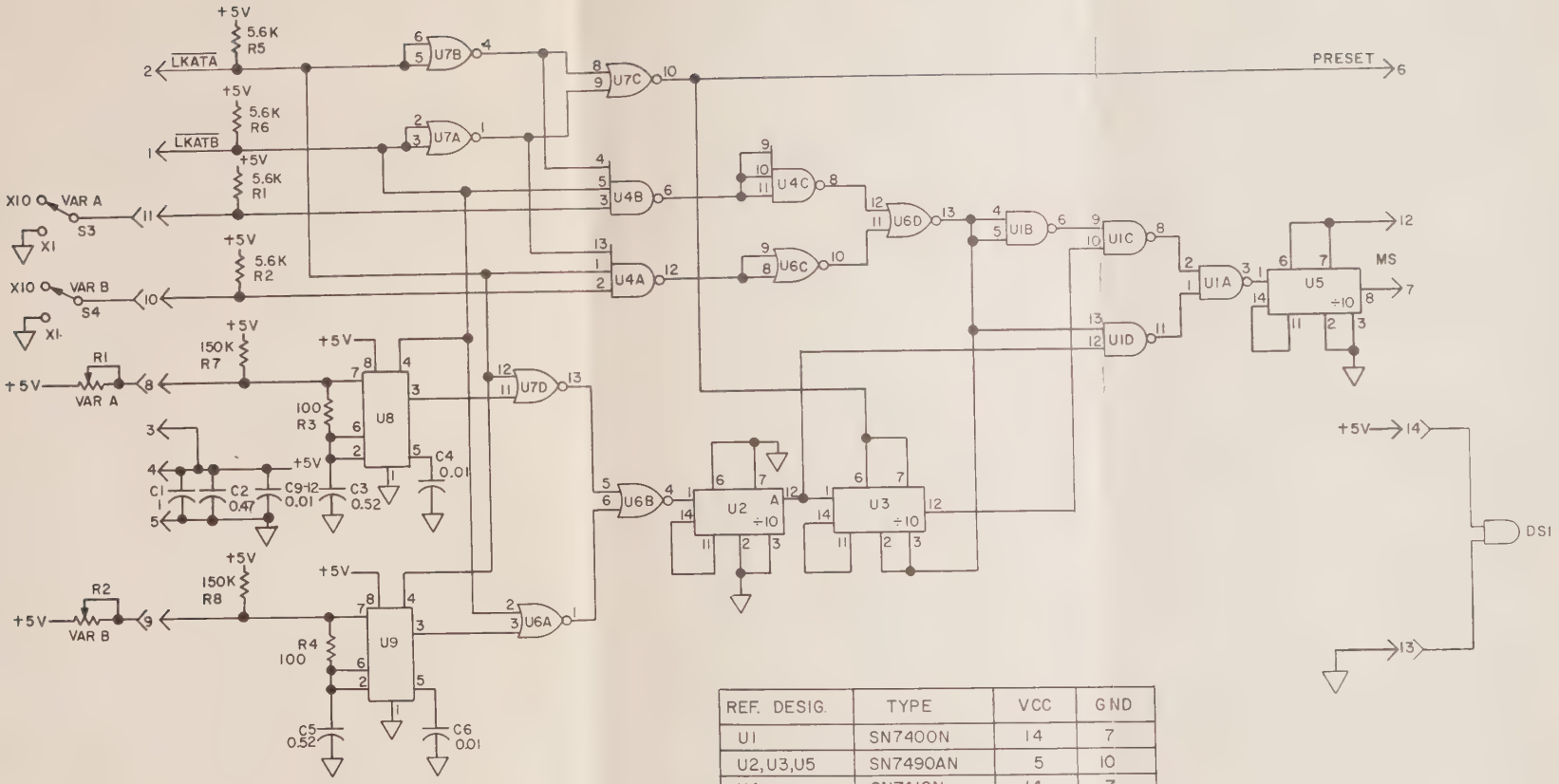


Figure 6—9. Variable Timer Circuit Board PC4 (9672
Component Location.



REF. DESIG.	TYPE	VCC	GND
U1	SN7400N	14	7
U2,U3,U5	SN7490AN	5	10
U4	SN7410N	14	7
U6,U7	SN7402N	14	7
U8,U9	NE555V	8	1

00507

VARIABLE TIMER	
NE PART NO.	A0075-12-012
REF DESIG	PC4
PC NO.	96727

Figure 6—10. Variable Timer PC4, (96727) Schematic Diagram.

NOTE: Q7 IS LOCATED AT TERM.
E, C, AND B.

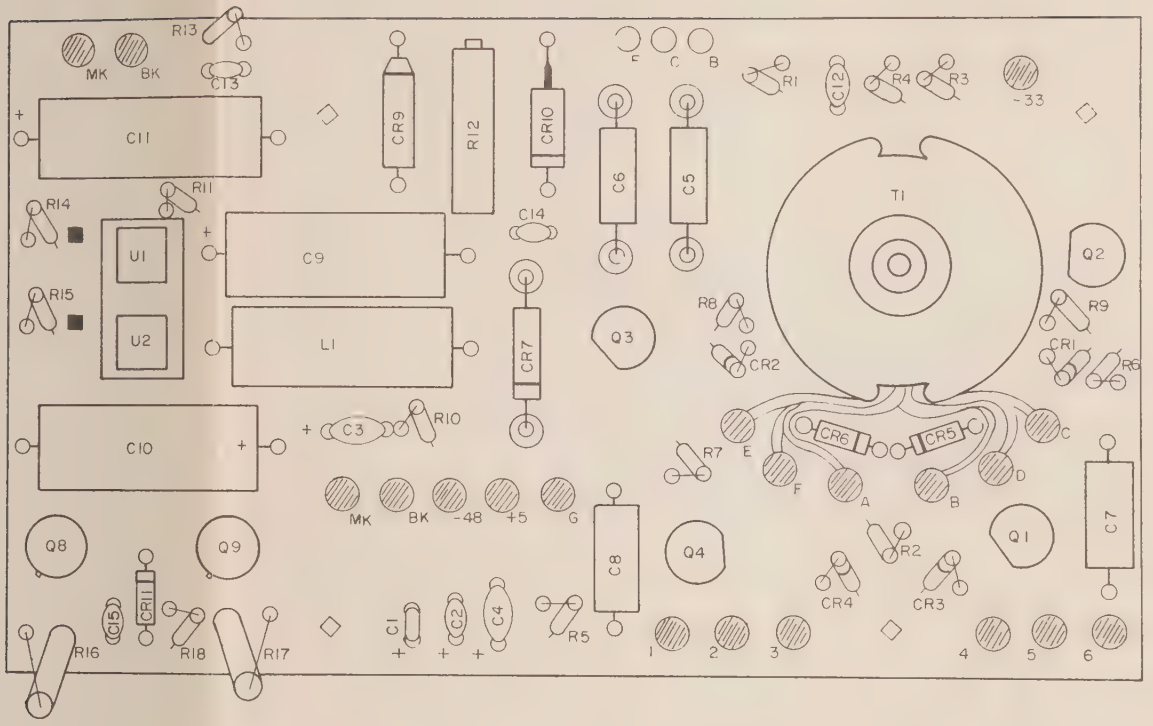
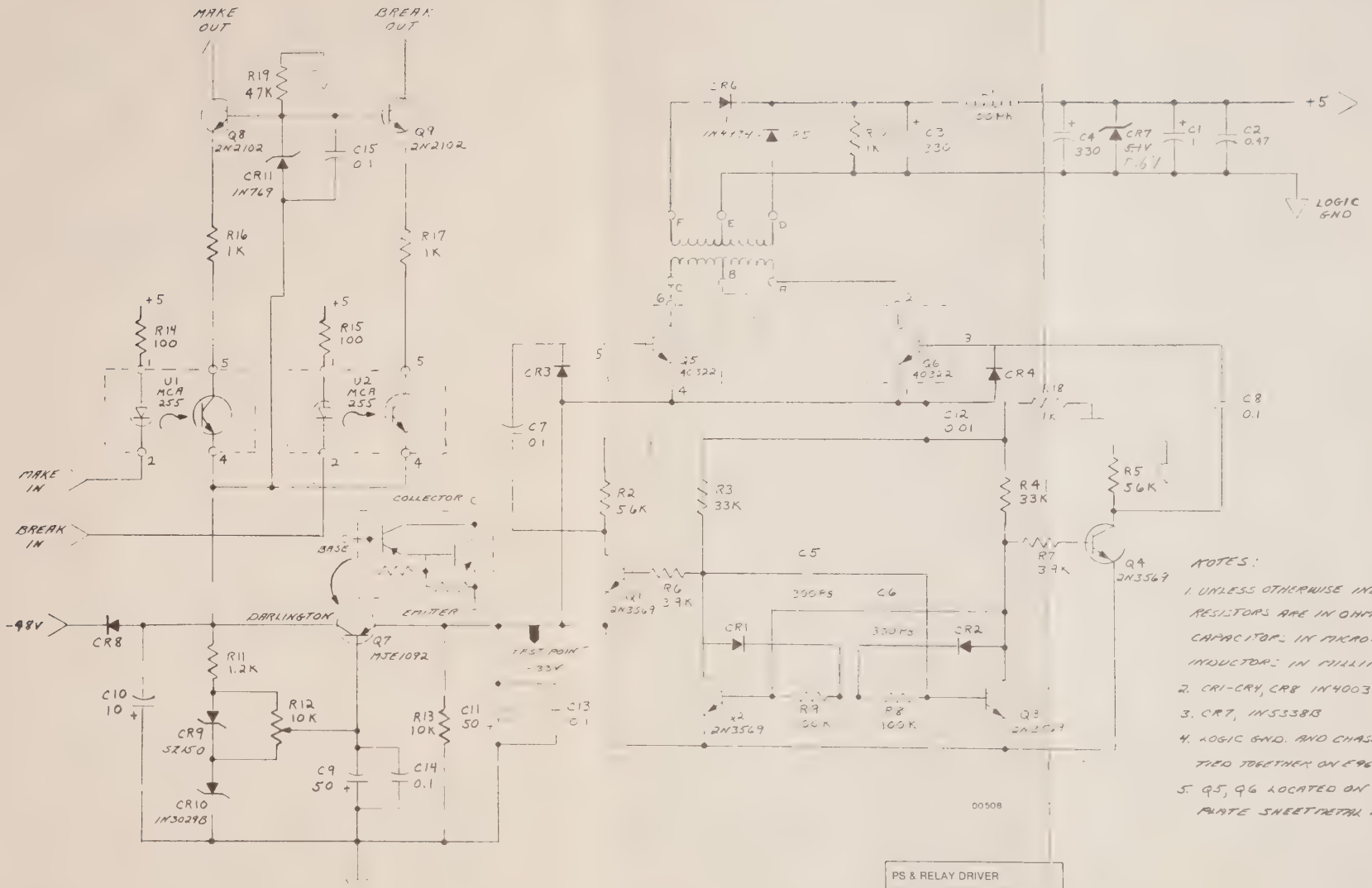


Figure 6—11 Power Supply and Relay Driver Circuit Board PC5 (96148) Component Location.

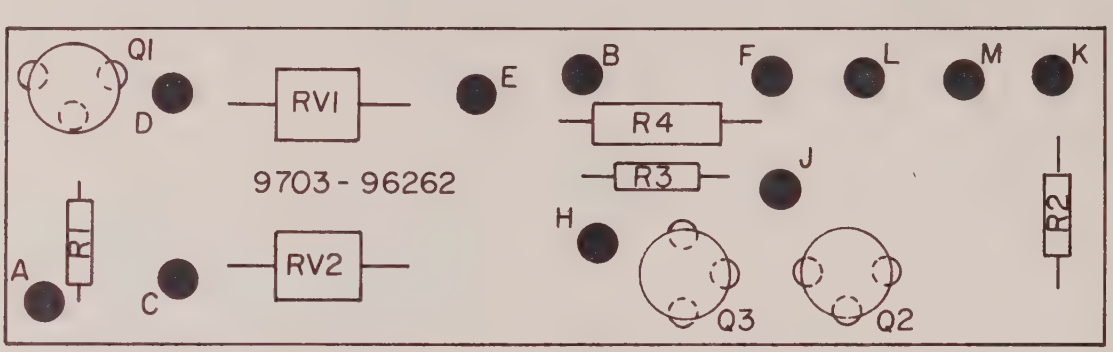


NOTES:

1. UNLESS OTHERWISE INDICATED RESISTORS ARE IN OHMS, CAPACITORS IN MICROFARADS INDUCTORS IN MILLIHENRYS
2. CR1-CR4, CR8 IN4003
3. CR7, IN5338B
4. LOGIC GND. AND CHASSIS GND TIED TOGETHER ON E96148 ONLY
5. Q5, Q6 LOCATED ON BASE-PLATE SHEETMETAL ASSEMBLY

PS & RELAY DRIVER	
NE PART NO	A0075-20-015
REF DESIG	PC5
PC NO	96148

Figure 6—12. Power Supply and Relay Driver PC5, (96148) Schematic Diagram.



00755

Figure 6—13. Spark Suppressor Circuit Board PC6 (96262) Component Location.

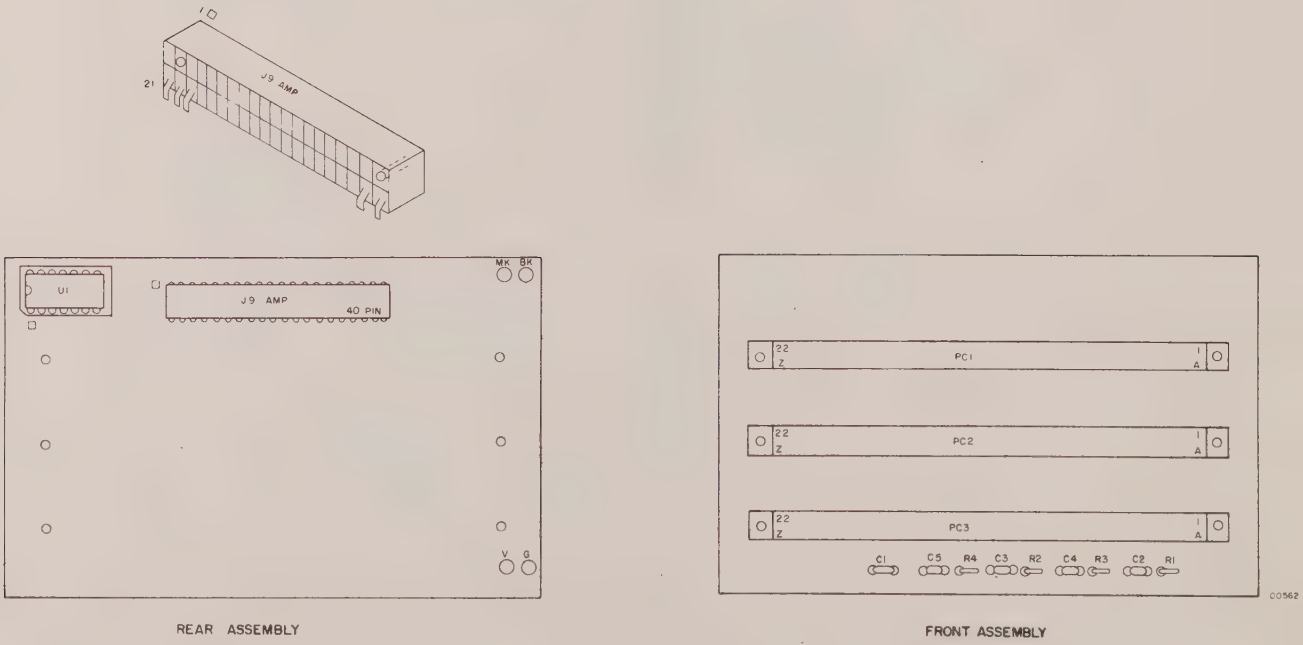
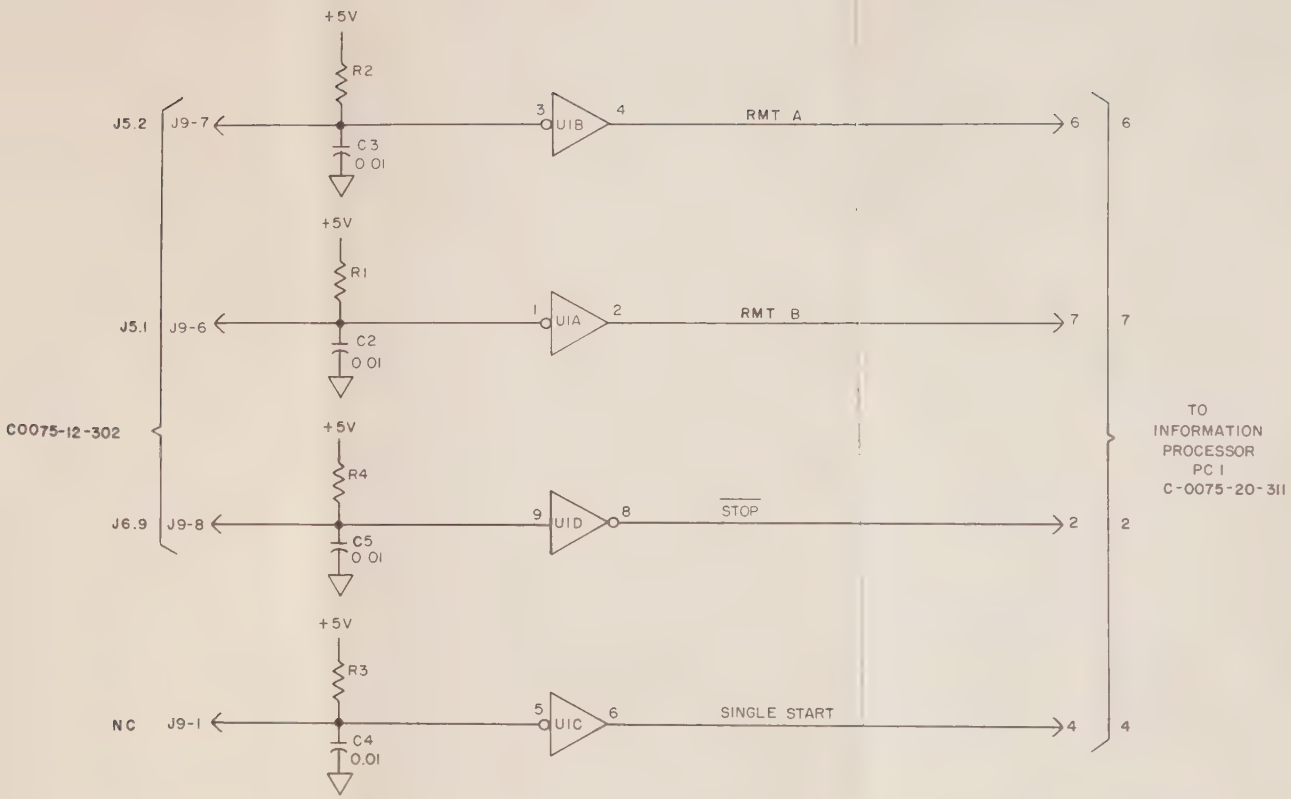
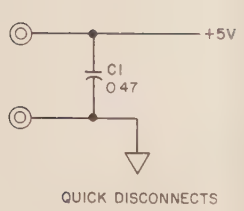


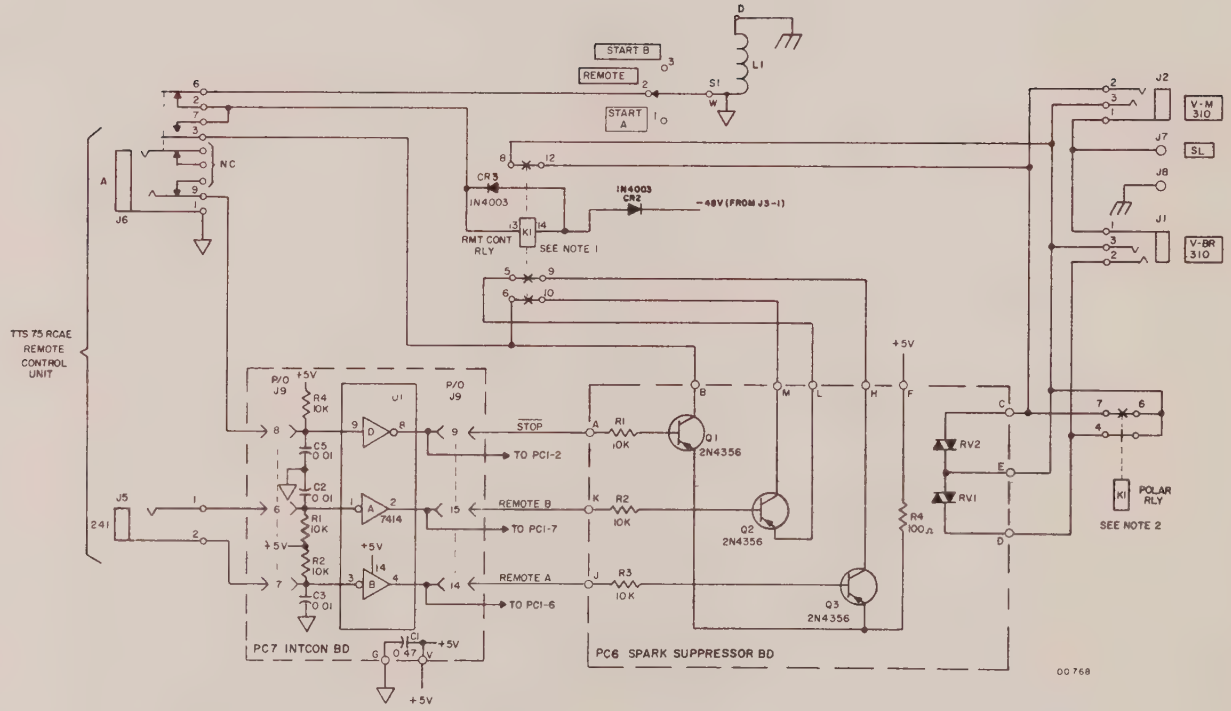
Figure 6—14. Interconnection Board PC7 Component Location





NOTES:
1. ALL RESISTORS ARE 10K, 1/8W, 10%
2. U1 IS SN7414 OR EQUIV.

Figure 6—15. Remote Control Interface PC6 Schematic Diagram



NOTES

1. REMOTE CONTROL RELAY K1 MOUNTED ON JACK BLOCK BRACKETS.
2. POLAR RELAY K1 MOUNTED ON BASE PLATE ASSEMBLY
3. UNLESS OTHERWISE INDICATED CAPACITOR VALUES ARE IN MICROFARADS

Figure 6—16. Remote Control Interfacing And Spark Suppressor PC6 And PC7 Schematic Diagram

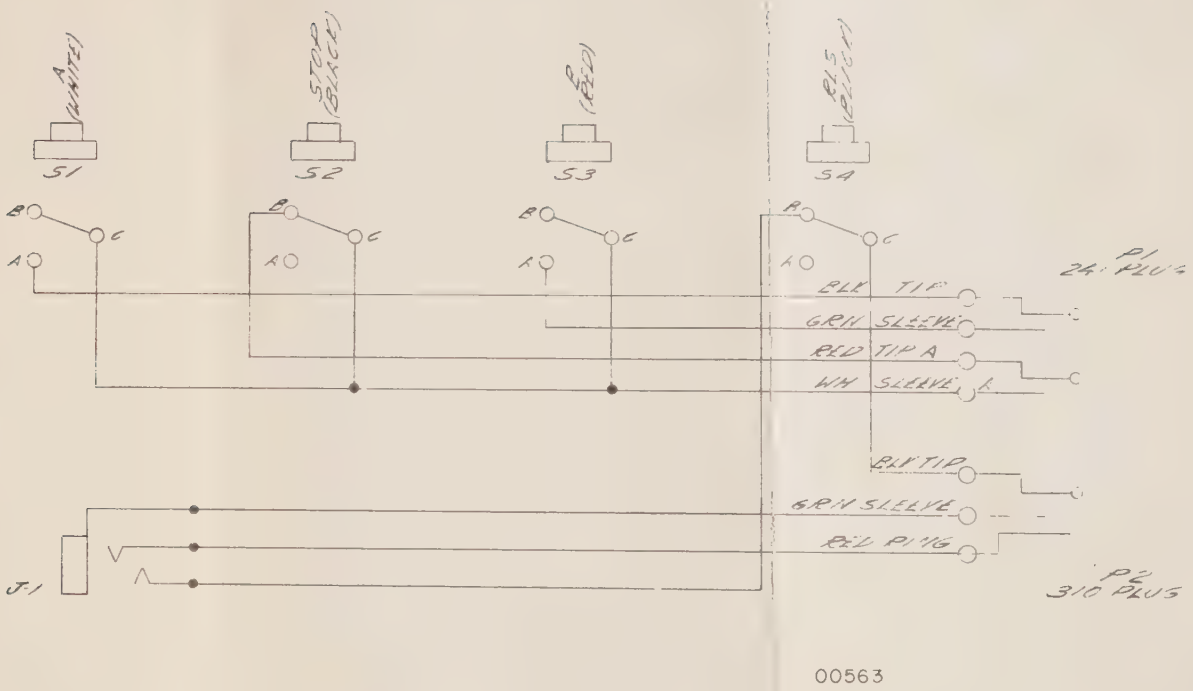


Figure 6—17. TTS 75RCAE Remote Control Schematic Diagram.

SECTION 7

ELECTRONIC PARTS LISTS

7.1 INTRODUCTION.

7.2 Tables 7—1 through 7—9 are the electronic parts lists for the TTS 75A.

Table 7—1. TTS 75A Overall Parts List.

REFERENCE DESIGNATOR	DESCRIPTION VALUE	POWER	TOL	VOLTS	MFGR.	MFGR. PART NO.	N.E.C. PART NO.
CR1-3	D041	1A	SI	200V	EDAL	1N4003	560040030
DS1	GRN PLAIN				SHELLY	BEPH-210-GBL	726001200
J1-2	JACK,TEL,SWCRFT SCHEM 4				SWCRFT	MT-332E	650400300
J3-5	JACK,TEL,SWCRFT SCHEM 1				SWCRFT	MT-331	650400100
J6	SPECIAL				SWCRFT	5J-1191	650400900
J7-8	BINDING POST METAL GND				H H SMITH	137SF	652500100
J9	40POS.				AMP	86671-7	654001200
K1	1K				SIGMA	72A0Z-1000TS-SIL	604700100
K2	2.6K			48V	MIDTEX	156-14D100	604100100
L1	2.7MH				DELEVAN	2500-48	450300100
PC1	PCB ASSY INFO PROCESSOR						A007520010
PC2	PCB ASSY PRESET TIMER						A007520011
PC3	PC B ASSY DIODE MATRIX						A007520012
PC4	ASSY 96727 VARIABLE TIMER						A007512012
PC5	PCB ASSY POWER&DRIVER						A007520015
PC6	SPARK SUPRSS 75B						A007520016
PC7	INTERCONNECTION BD						A007520026
PC8	FUSE BD. ASSY						A007512016
Q5-6	TO-66	35W	TC	NPN 300V	RCA	40322	550040322
Q7	CASE 90	70W	TC	PNP 80V	MOTOROLA	MJE1092	552001092
R1-2	10K	LIN,.5%	3%		SPECTROL	132-0-0-103	232001031
S1	1D-1CKT-3POS SHORT				OAK	268375-F1	625800300
S2-4	SPDT	5A		28V	C+K COMP	7101F3YZE	620400100
S5-6	SW,RDT,1D,1POL,23POS,N/S				CRL	PA4001	625400200
U1-2	.1UF		10%	250	F-DYNE	MPED2S-.1-250-10+1K	566000301

Table 7—2. Information Processor PC1 (96153) Parts List.

REFERENCE DESIGNATOR	DESCRIPTION VALUE	POWER	TOL	VOLTS	MFGR.	MFGR. PART NO.	N.E.C. PART NO.
C1	1UF		10%	35V	KEMET	T330A105K035AS	310001051
C2	.47UF	Y5V TC	20%	50V	ERIE	8131-050-651-474M	330804740
C4	1.0UF	Y5V TC	20%	50V	ERIE	8131-050-651-105M	330801050
C5-9	.01UF		20%	16V	CENTRALAB	UK16-103	330701031
C10	.001UF		20%	1KV	SPRAGUE	5GA-D10	330401020
C11	470PF		5%	500V	ELMENCO	CM05-D471JO-	335404710
R1-15	2.2K	1/8W	10%		AB	TYPE BB	200002226
U1	16DILP				TI	SN7445N	510074450
U2	14DILP				TI	SN7473N	510074730
U3	14DILP				TI	SN7406N	510074060
U4	16DILP				TI	SN7476N	510074760
U5	DILP				TI	SN7408N14P	510074080
U6	14DILP				TI	SN7400N	510074000
U7	14DIP				TI	SN7404N	510074040
U8	14DILP				TI	SN7410N	510074100
U9-10	14DILP				TI	SN7474N	510074740
U11	14DILP				TI	SN7400N	510074000
U12	14DILP				TI	SN74121N	510074121

Table 7—3. Preset Timer PC2 (96156) Parts List.

REFERENCE DESIGNATOR	DESCRIPTION VALUE	POWER	TOL	VOLTS	MFGR.	MFGR. PART NO.	N.E.C. PART NO.
C1	1UF		10%	35V	KEMET	T330A105K035AS	310001051
C2	.47UF	Y5V TC	20%	50V	ERIE	8131-050-651-474M	330804740
C3	.01UF		20%	16V	CENTRALAB	UK16-103	330701031
R1	200-	1/8W	1%		ELECTRA	RN55 SIZE 100 PPM	220220001
R2	200-	1/8W	1%		ELECTRA	RN55 SIZE 100 PPM	220220001
R3	470-	1/8W	10%		AB	TYPE BB	200004716
R4	470-	1/8W	10%		AB	TYPE BB	200004716
R5	2.2K	1/8W	10%		AB	TYPE BB	200002226
R6	2.2K	1/8W	10%		AB	TYPE BB	200002226
R7	2.2K	1/8W	10%		AB	TYPE BB	200002226
R8	2.2K	1/8W	10%		AB	TYPE BB	200002226
R9	2.2K	1/8W	10%		AB	TYPE BB	200002226
U1	14DILP				TI	SN7490AN	510074900
U2	14DILP				TI	SN7490AN	510074900
U3	14DILP				TI	SN7490AN	510074900
U4	14DILP				TI	SN7490AN	510074900
U5	14DILP				TI	SN7493AN	510074930
U6	14DILP				TI	SN7473N	510074730
U7	14DILP				TI	SN7493AN	510074930
U8	16 DIP				FAIRCHILD	93L24DC	510093024
U9	16 DIP				FAIRCHILD	93L24DC	510093024
U10	14DILP				TI	SN7405N	510074050
Y1	10MHZ				VALPEY	VM-6-10MHZ	919100900

Table 7—4. Diode Matrix PC3 (96127) Parts List.

REFERENCE DESIGNATOR	DESCRIPTION VALUE	POWER	TOL	VOLTS	MFGR.	MFGR. PART NO.	N.E.C. PART NO.
C1	1UF		10%	35V	KEMET	T330A105K035AS	310001051
C2	.47UF	Y5V TC	20%	50V	ERIE	8131-050-651-474M	330804740
CR1-117	DO35	500MW		75V	FAIRCHILD	1N4148	560041480
Q1-10	TO92HSS	310MW		40V	MOTOROLA	2N3903	550039030
R1-30	2.2K	1/8W	10%		AB	TYPE BB	200002226

Table 7—5. Variable Timer PC4 (96727) Parts List.

REFERENCE DESIGNATOR	DESCRIPTION VALUE	POWER	TOL	VOLTS	MFGR.	MFGR. PART NO.	N.E.C. PART NO.
C1	1UF	Z5U TC	20%	50V	SPRAGUE	5C023105X0500C5	330501050
C2	.47UF	Z5UTC	20%	25	SPRAGUE	5C023474X0500C5	330504740
C3	.52 MF		2%	50V	F-DYNE	MPC53S-.52-50-2	322505240
C4	.01UF		20%	16V	CENTRALAB	UK16-103	330701031
C5	.52 MF		2%	50V	F-DYNE	MPC53S-.52-50-2	322505240
C6	.01UF		20%	16V	CENTRALAB	UK16-103	330701031
C9-12	.01UF		20%	16V	CENTRALAB	UK16-103	330701031
R1-2	5.6K	1/4W	10%		AB	TYPE CB	200105626
R3-4	100-	1/4W	10%		AB	TYPE CB	200101016
R5-6	5.6K	1/4W	10%		AB	TYPE CB	200105626
R7-8	150K	1/4W	10%		AB	TYPE CB	200101546

Table 7—5 (Cont'd)

U1	14DILP		TI	SN7400N	510074000
U2-3	14DILP		TI	SN7490AN	510074900
U4	14DILP		TI	SN7410N	510074100
U5	14DILP		TI	SN7490AN	510074900
U6-7	14DILP	500V	TI	SN7402N	510074020
U8-9	IC,ONE-SHOT TIMER 8DILP		SIGNETICS	NE 555V	510005550

Table 7—6. Power Supply and Driver PC5 (96148) Parts List.

REFERENCE DESIGNATOR	DESCRIPTION VALUE	POWER	TOL	VOLTS	MFGR.	MFGR. PART NO.	N.E.C. PART NO.
C1	1UF		10%	35V	KEMET	T330A105K035AS	310001051
C2	.47UF	Y5V TC	20%	50V	ERIE	8131-050-651-474M	330804740
C3-4	330UF	G	20%	6V	SPRAGUE	196D337X0006TE4	310803370
C5-6	300PF		5%	500V	ELMENCO	CM15-E301J	335003010
C7-8	.1UF		2%	100V	F-DYNE	MPC12-.1-1002	321801040
C9	50UF			50V	SPRAGUE	TE1307	300205063
C10	10UF			150V	SPRAGUE	TVA1406	300401060
C11	50UF			50V	SPRAGUE	TE1307	300205063
C12	.01UF	W5R TC	10%	50V	USCC	CW15C103K	330801030
C13-15	.1UF	Y5V TC	20%	50V	ERIE	8121-050-651-104M	330801040
CR1-2	DO41 DO 41			100V	MOTOROLA	1N4934	560049340
CR3-4	DO41			200V	EDAL	1N4003	560040030
CR5-6	DO41 DO 41			100V	MOTOROLA	1N4934	560049340
CR7	CASE 17	5W	5%	5.6V	MOTOROLA	1N5339B	562053390
CR9	A140	1W	1%	15V	SCHAUER	SZ15.0	562001500
CR10	A31A	1W	5%	24V	DICKSON	1N3029B	562030292
CR11	DO-7	400MW	10%	24V	MOTOROLA	1N970A	562007690
L1	100UH	1.0A	10%		CADL-BURNS	6150-7	450500200
Q1-4	TO92AFA	310MW		400V	FAIRCHILD	2N3569	550035690
Q8-9	TO5HNS	1W		65V	RCA	2N2102	550021020
R1	1K	1/4W	10%		AB	TYPE CB	200101026
R2	5.6K	1/2W	10%		AB	EB	200205626
R3-4	33K	1/2W	10%		AB	TYPE EB	200203336
R5	5.6K	1/2W	10%		AB	EB	200205626
R6	3.9K	1/4W	10%		AB	TYPE CB	200103926
R7	3.9K	1/4W	10%		AB	TYPE CB	200103926
R8-9	100K	1/4W	5%		AB	TYPE CB	200101045
R10	1K	1/4W	10%		AB	TYPE CB	200101026
R11	1.2K	1/2W	10%		AB	TYPE EB	200201226
R12	10K	.75W	10%		HELIPOT	89PR10K	232501030
R13	10K	1/2W	10%		AB	TYPE EB	200201036
R14-15	100-	1/4W	10%		AB	TYPE CB	200101016
R16-17	1K	1W	10%		AB	TYPE GB	200301026
R18	4.7K	1/2W	10%		AB	TYPE EB	200204726
T1	TRANSFORMER,POT CORE				ARTTED	AC8392	420900100
U1-2	RELAY,PHOTO DARLINGTON				MONSANTO	MCA2-55	515000100

Table 7—7. Spark Suppressor PC6 (96262) Parts List.

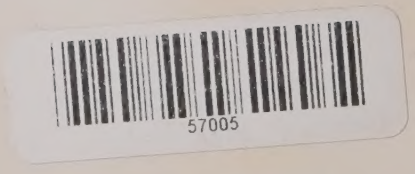
REFERENCE DESIGNATOR	DESCRIPTION VALUE	POWER	TOL	VOLTS	MFGR.	MFGR. PART NO.	N.E.C. PART NO.
Q1	TO105LNA	350MW		80V	FAIRCHILD	2N4356	552043560
Q2	TO105LNA	350MW		80V	FAIRCHILD	2N4356	552043560
Q3	TO105LNA	350MW		80V	FAIRCHILD	2N4356	552043560
R1	10K	1/4W	10%		AB	TYPE CB	200101036
R2	10K	1/4W	10%		AB	TYPE CB	200101036
R3	10K	1/4W	10%		AB	TYPE CB	200101036
R4	100-	1/2W	10%		AB	TYPE EB	200201016
RV1	VARISTOR MET OXIDE				GE	V250LA4	565500250
RV2	VARISTOR MET OXIDE				GE	V250LA4	565500250

Table 7—8. Interconnection Board PC7 Parts List.

REFERENCE DESIGNATOR	DESCRIPTION VALUE	POWER	TOL	VOLTS	MFGR.	MFGR. PART NO.	N.E.C. PART NO.
C1	.47UF	Y5V	TC 20%	50V	ERIE	8131-050-651-474M	330804740
C2-5	.01UF	W5R	TC 10%	50V	USCC	CW15C103K	330801030
R1	10K	1/8W	10%		AB	TYPE BB	200001036
R2	10K	1/8W	10%		AB	TYPE BB	200001036
R3	10K	1/8W	10%		AB	TYPE BB	200001036
R4	10K	1/8W	10%		AB	TYPE BB	200001036
U1	14DILP				TI	SN7414N	510007414

Table 7—9. Fuse Board PC8 (96672) Parts List.

REFERENCE DESIGNATOR	DESCRIPTION VALUE	POWER	TOL	VOLTS	MFGR.	MFGR. PART NO.	N.E.C. PART NO.
CR1	D041			200V	EDAL	1N4003	560040030
F1	SUBMINI PICO-FUSE RADIAL				LITTELFUSE	276.500	863201100
F2	FUSE,PICO FUSE RADIAL				LITTELFUSE	~~276.750~~ 1 Amp	863200500
PC8	FUSE BD.						970096672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